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Forty-third Annual Report

OF

The Connecticut Agricultural Experiment Station

Being the annual report for the year ended October 31

1919

and including Bulletins Nos. 215 to 222

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NEW HAVEN
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1920

Publication

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the Board of Control.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF

October 31, 1919.

BOARD OF CONTROL.

His Excellency, Marcus H. Holcomb, *ex-officio, President.*

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George A. Hopson, *Secretary*...............................New Haven
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Elijah Rogers ....Southington
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STAFF.

Administration.
E. H. Jenkins, Ph.D., *Director and Treasurer.*
Miss V. E. Cole, *Librarian and Stenographer.*
Miss L. M. Brautlecht, *Bookkeeper and Stenographer.*
William Veitch, *In charge of Buildings and Grounds.*

Chemistry.

Analytical Laboratory.
E. Monroe Bailey, Ph.D., *Chemist in Charge.*
C. E. Shepard, H. D. Edmond, B.S., Michael D'Esopo, Ph.B., *Assistant Chemists.*
Frank Sheldon, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Miss A. H. Moss, *Clerk.*

Protein Research.
T. B. Osborne, Ph.D., D.Sc., *Chemist in Charge.*

Botany.
G. P. Clinton, Sc.D., *Botanist.*
E. M. Stoddard, B.S., *Assistant Botanist.*
Miss Florence A. McCormick, Ph.D., *Scientific Assistant.*
G. E. Graham, *General Assistant.*
Mrs. L. D. Kelsey, *Stenographer.*

Entomology.
W. E. Britton, Ph.D., *Entomologist; State Entomologist.*
B. H. Walden, B.Agr., I. W. Davis, B.Sc., M. P. Zappe, B.S., Philip Garman, Ph.D., K. F. Chamberlain, *Assistant Entomologists.*
Miss Gladys M. Finley, *Stenographer.*

Forestry.
Walter O. Filley, *Forester, also State Forester and State Forest Fire Warden.*
A. E. Moss, M.F., *Assistant State and Station Forester.*
H. W. Hicock, M.F., *Assistant.*
Miss Etta L. Avery, *Stenographer.*

Plant Breeding.
Donald F. Jones, S.D., *Plant Breeder.*
C. D. Hubbell, *Assistant.*

Vegetable Growing.
W. C. Pelton, B.S.

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ERRATA.

Page 90, line 3, for 12536 read 12537.

Page 94, second line from the bottom, reference "2" to a foot-note. Should be dropped to the bottom line.

Report of the Board of Control

OF

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

To His Excellency, Marcus H. Holcomb, Governor of Connecticut:

As required by law, the Board of Control of The Connecticut Agricultural Experiment Station herewith respectfully presents its report for the year ending October 31, 1919.

For the first time in its history, this Station has lost by death an active member of its scientific staff.

Miss Edna Louise Ferry, a graduate of the New Haven High School and of Mount Holyoke College, after graduate study in the Sheffield Scientific School of Yale University, specializing in physiological chemistry, in 1913 received the degree of Master of Science, being the first woman to receive this degree from Yale.

In 1909 Miss Ferry accepted an engagement in the research laboratory of this Station and held this position until her death, on October 7, 1919.

By her collaboration in the numerous contributions to scientific journals made by the research department, Miss Ferry achieved wide recognition among students of nutrition.

Miss Ferry's address on The Food Value of Milk, delivered at the last annual meeting of the Dairymen's Association, was a clear exposition of the subject, in the joint interest of producers and consumers, and created very unusual interest in the research work of this Station.

By her ability she won a place among scientific investigators and by her high courage in the face of very difficult conditions she earned the respect and affectionate regard of all her associates.

Legislation Concerning the Station.

The General Assembly, January Session, 1919, passed the following acts affecting this Station:

Chapter 181 provides that the botanist, entomologist and forester of the Station shall examine any applicant as to his

qualifications to improve, protect, or preserve trees, and to issue certificates of such qualification, and that no person without such certificate shall do work of protecting and preserving trees, outside of the town in which he resides.

Chapter 21 amends the statute concerning mosquito breeding areas by providing that the cost of supervision and inspection shall be wholly borne by the State.

Chapter 204 repeals the fertilizer law formerly in force and enacts a new one. The more important differences between the two are in the definition of the term commercial fertilizers, which now includes cotton seed meal, ashes and vegetable meals used as fertilizers, in the provision for a tonnage fee as well as a registration fee, and in the directions for sampling.

Chapter 257 authorizes the building of a laboratory for the joint use of the State Department of Health and this Station and appropriates one hundred thousand dollars therefor.

House Bill No. 765, file number 689, appropriates for the biennial period beginning July 1, 1919,

For the Station's current expenses	$45,000.00
Food and drug investigations	5,000.00
Suppression of gypsy and brown-tail moths and inspection of imported nursery stock	70,000.00
Suppression of bee diseases	4,000.00
Control of white pine blister rust	10,000.00
Mosquito elimination	10,000.00
State entomologist	15,000.00
State forester's expenses	6,000.00
Purchase of forest land	5,000.00
Fire warden service	10,000.00

A brief summary of the more important work of each department of the Station follows:—

The Botanical Department.

Dr. Clinton in Charge.

This department has made a very comprehensive and important study of the white pine blister rust, concerning chiefly its botanical relations and the channel of infection of the pine. The

account of this investigation is nearly ready for distribution as Bulletin No. 214.

Fertilizer experiments in a peach orchard at Yalesville and a study at Mt. Carmel of fertilizers in relation to diseases of garden crops have been continued.

In addition to the plant disease survey which Doctor Clinton has carried on for years, there has been a special survey, with reference to the possible presence of potato wart disease in the State, the Station coöperating with the Bureau of Plant Industry of the U. S. Department of Agriculture.

Spraying experiments with apples and peaches, potato variety tests, and further study of peach yellows have also been carried on. Two hundred and fifty-three samples of seeds have been tested, either for purity or vitality, in the interest of both seedsmen and farmers.

The Chemical Department.

Dr. Bailey in Charge.

The work of the year, largely under statute requirements, has involved analyses of 873 samples of commercial and other fodder materials and field crops, over 500 samples of fertilizers and about 2250 samples of food and drug products. Also, 1540 pieces of Babcock glassware have been examined, as to their accuracy of calibration.

Expert testimony in court has been required in 15 cases.

An exhibit was prepared to represent the work of the analytical laboratory, at the Farmers' Week exhibit in Hartford, in January of this year.

Publications from this department include the regular annual report on Fertilizers, Bulletin 209; Food Products and Drugs, Bulletin 210; Commercial Feeding Stuffs, Bulletin 212, and Condensed Milk, Malted Milk, Milk Powder, Bulletin 213. The chemist in charge has assisted the Dairy and Food Commissioner and the Director of this Station in preparing additions to the Rules and Regulations relating to the State Food and Drug Law, and has continued to serve as expert on diabetic foods for the American Medical Association, and as a Referee of the Association of Official Agricultural Chemists.

THE ENTOMOLOGICAL DEPARTMENT.

Dr. Britton in Charge.

The inspection work required by Statute has included the examination of 96 nurseries, 1075 cases of imported nursery stock, 249 cases of bulbs, and 707 apiaries containing 5861 colonies of bees.

In coöperation with the Federal Bureau of Entomology, the fight to control the gypsy moth has been carried on vigorously and fewer infestations have been found this year.

On account of the menace of the European corn borer, considerable scouting has been done throughout the State, but up to the present this pest has not been found.

Experiments have been carried on in two large greenhouses, to control the chrysanthemum midge, a serious imported pest, and in the experiment field studies have been continued on insects attacking cucurbits, the results of which will shortly be published.

Some time has been given to the preparation of papers to be published by the State Geological and Natural History Survey.

Mr. Walden has continued his duties as deputy to the Director, in charge of mosquito elimination. In this connection there has been little new work undertaken, but the work of maintenance has been carried on as effectively as the scarcity of efficient labor would permit.

Dr. Philip Garman, who began his duties September 1, 1919, is studying the biology of the bulb mite.

The entomologist has coöperated with the farm bureaus and has furnished information about insect pests whenever needed. He also serves as Chairman of the Tree Protection Examining Board.

The entomologist has prepared Bulletin 211, being his eighteenth annual report, and Bulletin 208, Insects Attacking the Potato Crop in Connecticut.

THE FORESTRY DEPARTMENT.

Mr. Filley in Charge.

In the Portland state forest 30,000 pines have been set on cut-over land and 65,000 seedlings have been transplanted at Mt. Carmel, for use in the forest next year.

The cutting of chestnut ties and poles is continued, the product finding a ready market.

No planting has been done in the other state forests because of difficulty in getting labor. The area of the state forests has been increased this year by 254 acres, making the amount now owned by the State 3970 acres.

There were 1028 forest fires in 1918, only 100 occurring in the fall. In 1919, 627 forest fires occurred previous to July 1st, burning over 22,000 acres, with an estimated property damage of $58,000.00.

The forester is by law a member of the State Park Commission. The Commission, in the six years of its existence, has acquired 4000 acres of park land in different parts of the State. This is largely in woodland and the forester has been called upon for advice as to its value and treatment and he is responsible for all forestry operations in these State parks. During the summer and fall Mr. Moss has been doing the field work for a forest map of the Macedonia Brook tract of 2000 acres, in Kent, the expense being borne by the Park Commission.

The work of controlling the blister rust has been done in coöperation with the botanical department. The eradication work in Norfolk has been extended this year and similar work has been done on a much smaller area in Pomfret. The work of past years in Norfolk shows encouraging results in the lessening amount of infected material.

The Department of Market Gardening.

Mr. Pelton in Charge.

Variety tests of beans, tomatoes, celery, peas, melons, squashes, and pumpkins have been conducted. The coöperative celery test reported last year was replaced by a strain test of Easy Blanching and Paris Golden, the two varieties now of most interest in Connecticut. The tests of peas and melons were intended to determine the value of certain local varieties not commonly known outside of the State. Squash and pumpkin testing was undertaken, to get data that would be of help in the judging of these vegetables at state and local fairs. Several varieties of western beans that have now been under observation for two years will be dropped from further trial.

The sweet corn cross of Stowell's Evergreen and Golden Bantam was tested again, in comparison with fifteen commercial types of similar crosses, and as it proved inferior to some of

these and superior to none of the best white varieties known, its planting will be discontinued.

A start has been made on two new projects outlined during the winter. Under the cover crop project, notes have been made on nine types of vetch and on the relative rapidity and volume of growth of some of the common crops used for green manuring. A series of plots has been laid out for comparative tests of cover crops and fertilizers with animal manures and fertilizers in rotations of vegetable crops. These plots have been in operation for one year.

Work on the project entitled "Standardization of Vegetable Crops" has consisted entirely of strain tests of beets, carrots, and string beans which were arranged to determine to what extent the variability of the seed affects the variability of the commercial product.

Owing to the fact that an extra field meeting was held by the Connecticut Vegetable Growers' Association, of which the Market Gardener is Secretary, and a longer excursion conducted, more than the usual amount of time has been devoted to the needs of that Association.

Researches Supported by the Adams Fund.

Dr. Osborne and Dr. Jones in Charge.

It is required by the Federal authorities that the Adams fund received from the United States shall be spent wholly in scientific investigation on subjects approved by the Office of Experiment Stations and preferably on projects continued through a term of years.

One of these, in charge of Dr. Osborne, is a study of the different protein bodies found in food products and of their relative value in nutrition.

The principal subjects to receive attention in this department during the past year have been the distribution of the water-soluble vitamine among fresh vegetables and green fodders; the preparation of protein free from this vitamine; the relative proportion of the fat-soluble vitamine in numerous vegetable products used for human food and for feeding farm animals and the relative nutritive value of wheat, rye, oats, and barley, when these grains serve as the sole source of protein in the ration.

The other Adams project, in charge of Dr. Jones, is a study of the laws of inheritance in maize and tobacco.

Particular study is devoted to the application of the principles, learned from the long continued experiments on inbreeding and cross-breeding, to methods of improving maize.

Some important results of this study are given by Dr. Jones in Bulletin 207, The Effects of Inbreeding and Cross-breeding upon Development.

The new variety of tobacco produced by the crossing of standard varieties, followed by many years of selecting for uniformity and constancy, is being tested on an extensive scale in many different parts of the State, with promising results.

In this connection, but not supported by the Adams fund, a coöperative corn variety test has been carried on at Storrs and at the New Haven Station which has yielded information concerning desirable varieties of corn for Connecticut and sources of seed. A summary of the results of this test has been prepared, making a mimeograph paper of 18 pages, giving the results of seven years' work, names of persons from whom seed of desirable varieties may be obtained, and a map of the State, showing the corn varieties specially recommended for different sections of the State.

Conferences and Field Meetings.

At the exhibition in connection with Farmers' Week in Hartford, January 20-24, 1919, the Station showed material illustrating the different departments of its work, filling the space allotted to it.

On Monday, June 2d, there began a conference of the county agents and other members of the Extension Service with the staff of this Station. The aim of this meeting was to get better acquaintance, both with the members of the staff and with the scope and, to some extent, with the results of our work. The conference continued for three days and proved to be mutually profitable.

On July 22d and 23d was held an institute for tree workers. The object was to have experts discuss those matters connected with the treatment of trees which were of special importance to those who were applying for licenses to practice as tree surgeons.

The examinations of applicants for licenses showed that need of this kind of instruction was quite urgent.

A conference of plant pathologists, chiefly from the eastern states, was held August 18th-21st. There were sessions for papers and discussions both here and at the Storrs Station, which were also attended by the county agents and others. Trips were made to farms in various parts of the State, where there were matters of special interest to students of plant diseases.

The annual Station field day was on August 24th. There were about 400 present at Mt. Carmel to inspect the experimental work being done there and to hear some discussion by experts of present potato problems.

On October 23d and 24th a conference of county agents and Extension Service workers was held in the state forest at Portland, where the Station forester discussed the care of woodland belonging to farmers, illustrated by the work going on at the forest under his direction.

Changes in the Station Staff.

Major John P. Street, chief of the chemical department, absent on leave in the U. S. service at the time of our last report, resumed his place on the staff on June 19th, but resigned on August 1st, to accept a position with the National Canners Association, in Indianapolis, at a much higher salary than he received here.

Lieut. C. B. Morison, chemist, returned to the Station from army service in February, 1919, but resigned in October to take a position in the American Institute of Baking, in Minneapolis, also at a much higher salary.

Corp. Irving W. Davis, assistant entomologist and deputy in charge of gypsy moth work, returned to his duties on Jan. 15, 1919, after six months' service in the U. S. Marine Corps.

Mr. Henry W. Hicock was engaged in September as an assistant in the forestry department.

Publications.

During the year the Station has issued the annual report for 1918, consisting of Bulletins 207-214, and Bulletin of Information No. 9, aggregating 506 pages, with 44 full page plates.

A considerable part of the Station's work, particularly in scientific research, cannot be printed in its bulletins, partly for lack

of space and partly because it is not of immediate value to farmers, to whom the larger part of our editions is sent.

Following is a list of papers written by the staff and published elsewhere:

By Dr. Jones.

Some Factor Relations in Maize with Reference to Linkage. (Jones and Gallastegui.) Amer. Naturalist; 53, 239-246.

Selection of Pseudo-Starchy Endosperm in Maize. Genetics; 4, 354-393.

Inbreeding and Outbreeding: Their Genetic and Sociological Significance. (East and Jones.) 1919. A book published by Lippincott, Philadelphia.

Inbreeding in Corn Improvement. Breeder's Gazette; May 8, 1919, 1111-1113; May 15, 1919, 1182; May 22, 1919, 1245.

Hybrid Vigor and Its Meaning. Scientific American; Sept. 6, 1919, 230-231, 239-241.

What Puts the "Pop" in Pop Corn. Rural New Yorker; Jan. 18, 1919, 74.

Some Curious Freaks of Corn. Rural New Yorker; July 5, 1919, 1043.

By Dr. Osborne and others in his Department.

In the Journal of Biological Chemistry:

The Vitamines in Green Foods. Osborne and Mendel. 1919, XXXVII, 187-200.

A Method of Expressing Numerically the Growth-Promoting Value of Proteins. Osborne, Mendel and Ferry. 1919, XXXVII, 223-229.

The Nutritive Value of the Wheat Kernel and Its Milling Products. Osborne and Mendel. 1919, XXXVII, 557-601.

The Nutritive Value of Yeast Protein. Osborne and Mendel. 1919, XXXVIII, 223-227.

Nutritive Factors in Plant Tissues. II. The Distribution of Water-Soluble Vitamine. Preliminary Report. Osborne and Mendel. 1919, XXXIX, 29-34.

Preparation of Protein Free from Water-Soluble Vitamine. Osborne, Wakeman and Ferry. 1919, XXXIX, 35-46.

In the Proceedings of the Society for Experimental Biology and Medicine:

Vitamines in Green Leaves. Osborne and Mendel. 1918, XVI, 15-16.

The Extraction of "Fat-Soluble Vitamines from Green Foods." Osborne and Mendel. 1919, XVI, 98-99.

In the Boston Medical and Surgical Journal:

The Chemistry of Nutrition. (Correspondence.) Osborne. 1919, CLXXXI, 77.

In the Proceedings of the Amer. Physiological Society. Amer. Journal Physiology:

The Nutritive Value of Yeast Protein. Osborne and Mendel. 1919, XLIX, 138.

In the Conn. Dairymen's Association's 38th Report:

The Food Value of Milk. Edna L. Ferry. 17-49.

In the Rural New Yorker:

The Food Value of Milk. Osborne. May 3, 1919, 765-766.

Seven articles by Osborne:

Vitamines: The Life-Giving Food Elements. The Absolute Necessity of Milk. Part I, June 21, 1919, 985-986.
Part II, June 28, 1919, 1019-1020.

The Story of the Vitamines: A Thorough Discussion of the Vital Principles of Food. Part I, Aug. 23, 1919, 1229-1230.
Part II, Aug. 30, 1919, 1263-1264.
Part III, Sept. 6, 1919, 1294.
Part IV, Sept. 13, 1919, 1333.
Part V, Sept. 20, 1919, 1383.

By Dr. Britton.

In the Florists' Exchange:

The Iris Borer Again. 1918, XLVI, 531.
The Chrysanthemum Midge. 1919, XLVI, 45.
Insects Attacking Maples and Elms. 1919, XLVII, 1331.
A Tree Protection Institute. 1919, XLVIII, 205.

In Science:

Book-Review: Washburn's Injurious Insects and Useful Birds. 1919, XLIX, 425.

In the Conn. Vegetable Growers' Association's Report, 1918:

Report of Committee on Injurious Insects, p. 28.

In the Proceedings, Fifth Annual Meeting, New Jersey Mosquito Extermination Association, 1918:

Progress in Mosquito Control in Connecticut in 1917, p. 100.

In the American Fruit Grower:

Automobile Truck Power Sprayers. Oct., 1919, p. 6.

In the Journal of Economic Entomology:

Kerosene Emulsion *vs.* Nicotine Solution for Combating the Potato Aphid. (Britton & Zappe.) 1919, XII, 71.

Other activities of members of the staff may be seen from the following figures:

Letters written	9,654
Addresses at meetings of farmers	60
Papers in scientific journals	20
Contributions in papers and magazines	27
Specimens of insects and fungi identified in answer to inquiries	536
Additions to herbarium	325
Seed samples tested	253

All of which is respectfully submitted.

(Signed) George A. Hopson,
Secretary.

New Haven, Connecticut, October 31, 1919.

REPORT OF THE TREASURER

June 30, 1919.

E. H. Jenkins, in account with The Connecticut Agricultural Experiment Station for the *nine months** ending June 30, 1919.

Receipts.

Balance on hand, October 1, 1918 (Analysis Fees)		$308.91
State Appropriation, Agriculture	$14,062.50	
State Appropriation, Food	1,875.00	
State Appropriation, Insect Pest	4,500.00	
United States Appropriation, Hatch	6,250.00	
United States Appropriation, Adams	6,250.00	
Analysis Fees	6,000.00	
Connecticut State Dept. of Health (rent)	150.00	
Miscellaneous Receipts	1,040.69	
From Lockwood Trust Income (including sale of Mt. Carmel Farm Produce, $2,161.67)	8,161.67	
		48,289.86
		$48,598.77

Disbursements.

E. H. Jenkins, director, salary		$2,100.00
E. H. Jenkins, treasurer,	"	300.00
V. E. Cole,	salary	858.33
L. M. Brautlecht,	"	558.33
J. P. Street,	"	86.66
T. B. Osborne,	"	1,800.00
E. M. Bailey,	"	1,800.00
C. B. Morison,	"	783.33
C. E. Shepard,	"	1,191.67
W. E. Britton,	"	1,950.00
G. P. Clinton,	"	1,950.00
E. M. Stoddard,	"	524.99
W. O. Filley,	"	1,875.00
A. E. Moss,	"	1,500.00
Edna L. Ferry,	"	990.00
D. F. Jones,	"	1,875.00
Michael D'Esopo,	"	787.50
Florence McCormick,	"	583.33
W. C. Pelton,	"	1,500.00
H. D. Edmond,	"	900.00
V. L. Churchill,	"	809.58
William Veitch,	"	627.91
Etta L. Avery,	"	396.00
C. D. Hubbell,	"	660.00
George E. Graham,	"	766.66
C. A. Gallastegui,	"	50.00
Alta H. Moss,	"	360.00
Mrs. L. D. Kelsey		431.20

* To conform with the fiscal year of the State.

Henry Kiley	$ 780.00	
Frank Sheldon	780.00	
Oliver J. Welch	780.00	
T. F. Barrows	580.00	
H. W. Edwards	693.33	
Kenneth Terrell	203.50	
Ervin Applegate	50.83	
Labor	2,591.80	
Publications	295.87	
Postage	149.44	
Stationery	283.58	
Telephone and Telegraph	163.38	
Freight and Express	176.42	
Gas, Electricity and Kerosene	764.31	
Coal	156.45	
Water	108.10	
Chemicals	705.11	
Laboratory Supplies	337.47	
Agricultural and Horticultural Supplies	147.82	
Miscellaneous Supplies	582.03	
Fertilizers	527.66	
Feeding Stuffs	419.50	
Library and Periodicals	534.54	
Tool, Machinery and Appliances (new)	724.86	
" " " " (repairs)	386 60	
Furniture and Fixtures (new)	311.12	
" " " (repairs)	62.17	
Scientific Apparatus (new)	111.20	
" " (repairs)	13.50	
Traveling by the Board	244.19	
Traveling by the Staff	802.44	
Gasoline for Automobiles	374.71	
Traveling in connection with Adams Fund Investigations	74.72	
Insurance	654.51	
Insect Pest Appropriation to State Entomologist	4,500.00	
Contingent	247.95	
New Buildings	2.48	
Betterments	38.50	
Repairs	201.43	
Grounds	12.00	
Total Disbursements		$48,589.01
Balance on hand, June 30, 1919 (Analysis Fees)		9.76
		$48,598.77

NEW HAVEN, CONN., Aug. 4, 1919.

THIS IS TO CERTIFY that we have audited the accounts of E. H. Jenkins, Treasurer of The Connecticut Agricultural Experiment Station, for the fiscal period Oct. 1, 1918, to June 30, 1919, inclusive, and have found them correct.

WILLIAM P. BAILEY,
JAMES P. TOBIN,
Auditors of Public Accounts.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN 215 DECEMBER, 1919

ECONOMY IN FEEDING THE FAMILY

THE FOOD VALUE OF MILK

BY EDNA L. FERRY

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The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

December, 1919.

BOARD OF CONTROL.

His Excellency, Marcus H. Holcomb, *ex-officio, President.*

James H. Webb, *Vice President*................................Hamden
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STAFF.

Administration.	E. H. Jenkins, Ph.D., *Director and Treasurer.* Miss V. E. Cole, *Librarian and Stenographer.* Miss L. M. Brautlecht, *Bookkeeper and Stenographer.* William Veitch, *In charge of Buildings and Grounds.*
Chemistry. **Analytical Laboratory.**	E. Monroe Bailey, Ph.D., *Chemist in charge.* R. E. Andrew, M.A., C. E. Shepard, H. D. Edmond, B.S., *Assistant Chemists.* Frank Sheldon, *Laboratory Assistant.* V. L. Churchill, *Sampling Agent.* Miss Alta H. Moss, *Clerk.*
Protein Research.	T. B. Osborne, Ph.D., D.Sc., *Chemist in Charge.*
Botany.	G. P. Clinton, Sc.D., *Botanist.* E. M. Stoddard, B.S., *Assistant Botanist.* Miss Florence A. McCormick, Ph.D., *Scientific Assistant.* G. E. Graham, *General Assistant.* Mrs. W. W. Kelsey, *Secretary.*
Entomology.	W. E. Britton, Ph.D., *Entomologist; State Entomologist.* B. H. Walden, B.Agr., Phillip Garman, Ph.D. M. P. Zappe, B.S., I. W. Davis, B.Sc., K. F. Chamberlain, *Assistants.* Miss Gladys M. Finley, *Stenographer.*
Forestry.	Walter O. Filley, *Forester, also State Forester and State Forest Fire Warden.* A. E. Moss, M.F., *Assistant State and Station Forester.* H. W. Hicock, M.F., *Assistant.* Miss E. L. Avery, *Stenographer.*
Plant Breeding.	Donald F. Jones, S.D., *Plant Breeder.* C. D. Hubbell, *Assistant.*
Vegetable Growing.	W. C. Pelton, B.S.

THE FOOD VALUE OF MILK

At the annual meeting of the Connecticut Dairymen's Association in January, 1919, Miss Edna L. Ferry of this Station gave an address with the above title.

"At the conclusion of Miss Ferry's address it was voted to ask the Experiment Station to prepare a bulletin on the food value of milk which could be distributed among consumers."

In response to the request this bulletin has been prepared, which is largely a transcript of Miss Ferry's paper. Her untimely death has put on others the work of editing it which has consisted chiefly in slight changes in form and arrangement.

Introduction.

Milk is the only food that supplies all of the food elements which the new-born animal must have in order to live and grow.

Among wandering Indian tribes the child whose mother fails to nurse it is doomed to die because no other milk can be had.

In countries where milch animals are scarce, as in Japan and China, mothers from necessity, if not from choice, nurse their children for relatively long periods, sometimes for two and even three years.

In countries where dairy cattle are abundant the cow is the foster mother of a large part of the infant population which for one reason or another does not have its mother's milk.

The world has had no more pitiful tragedies in the present war than the starving to death—or to life-long inefficiency—of a large infant population.

Hoover, who had the best chance to observe and who is given to sober statement without exaggeration, says:

"One of the first acts of the Germans was to denude the people of Belgium to a very large extent and the north of France almost wholly of their cattle. In consequence it has been necessary to maintain a stream of condensed milk for the whole of the last four years.

"The European races are absolutely dependent for the rearing of their young on these cattle. There is no cruelty to a population greater than to rob them of their dairy stock."

The need of milk is not limited to the first year of life. When the child is able to enlarge its diet and take solid food, milk is

an indispensable adjunct. Of the 27 brands of "infant foods" in market, which were examined by this Station (Report 1915, p. 324), 16 claim to contain milk and the directions for the use of 9 others prescribe mixture with milk.

All through childhood and youth bread and milk and cereal and milk are recognized as "growing foods."

Milk, too, is the most commonly prescribed food for adults in severe illness and a resource in time of sudden exhaustion.

It is hardly too much to say that public health, content and civilization follow the cow.

The work of Dr. Osborne at this Station has largely contributed to the discovery of the reasons for this unique value of milk which are leading to a greater appreciation and more rational use of it. This work has been in a way incidental to a general study of the character and function of proteins and of the laws of nutrition. The investigations on the chemistry of the proteins have been carried on for many years by Dr. Osborne and in the nutrition studies which followed he has had the valuable coöperation of Dr. Lafayette B. Mendel of Yale University.

Constitution of Proteins.

The foundation of our new knowledge regarding milk was laid by finding out and setting forth the composition and structure of a large number of different proteins, which are the flesh-growing materials of the body and an indispensable part of all the vital body fluids. This work showed for the first time their great variety and the fact that a nearly identical percentage composition of their elements (nitrogen, carbon, oxygen, hydrogen, and sometimes sulphur and phosphorus) went along with wide differences in structure and in physical and chemical properties; and that in the same food material, whether animal or vegetable, two or more proteins of quite different quality were usually found together.

Dr. Osborne's work, with that of others, showed that a protein was no such simple thing as salt or sugar, but was made up of about eighteen different complexes, knots of nitrogen-containing groups called amino-acids, each of them a complicated structure in itself.

The following table gives the names of these amino-acids, the approximate percentage of each in several of the common proteins and shows the striking differences in their amount.

Comparative composition of proteins.

AMINO-ACIDS	ZEIN (MAIZE)	GLIADIN (WHEAT)	CASEIN (MILK)	LACTALBUMIN (MILK)	EDESTIN (HEMP-SEED)
	per cent.	*per cent.*	*per cent.*	*per cent.*	*per cent.*
Glycocoll	0.00	0.00	0.00	0.00	3.80
Alanine	13.39	2.00	1.50	2.50	3.60
Valine	1.88	3.34	7.20	0.90	6.20
Leucine	19.55	6.62	9.35	19.40	14.50
Proline	9.04	13.22	6.70	4.00	4.10
Phenylalanine	6.55	2.35	3.20	2.40	3.09
Aspartic acid	1.71	0.58	1.39	1.00	4.50
Glutaminic acid	26.17	43.66	15.55	10.10	18.74
Serine	1.02	0.13	0.50	?	0.33
Tyrosine	3.55	1.50	4.50	2.20	2.13
Cystine	?	0.45	?	?	1.00
Histidine	0.82	1.49	2.50	1.53	2.19
Arginine	1.55	3.16	3.81	3.01	14.17
Lysine	0.00	?	7.61	8.10	1.65
Tryptophane, about	0.00	1.00	1.50	+	+
Ammonia	3.64	5.22	1.61	1.32	2.28
	88.87	84.72	66.92	56.46	82.28

In view of these great differences of structure and composition of proteins, the question arose: have they nevertheless about the same food value as has been assumed, or have they not? If they have not, the principles on which our whole art of cattle feeding is founded has lost a large part of its foundation.

Clearly, the only way to settle the question was to study the feeding effect of each protein by itself on both growth, maintenance and production.

Before the work here was begun, all experimenters who endeavored to feed animals on diets composed of pure nutrients failed. Both mature and young animals promptly declined in weight on such diets. To-day we have such an understanding of the influence of food on growth that merely by changing a single constituent of the diet we can stop the growth of a young animal at any stage of development, maintain it for many months in perfect health, but without growth, and later cause it to grow

again at a normal rate to full maturity and reproduce. It is due to the use of milk in the earlier attempts in feeding animals experimentally that we owe our success in developing methods of feeding which have opened up entirely new fields for investigation.

Our first attempts to make an animal grow on a mixture of pure protein, fat, carbohydrate and inorganic salts were no more successful than those of our predecessors, but we soon found that animals which failed to thrive on our artificial diets could be restored promptly to excellent condition by giving them a mixture of dried milk, starch and lard, and that control animals fed on a similar diet from weaning grew normally to full maturity and reproduced. Although the artificial diets were almost exactly like the milk diets, in respect to the kind and proportion of the then known nutrients, the milk diet was entirely adequate as a food, whereas the artificial diet was wholly inadequate. Wherein this profound difference lay was a mystery. By a process of elimination we were forced to the conclusion that the water-soluble portion of the milk contained something which was essential for life, and later that the fat component contained something which was indispensable for long-continued growth. This discovery that milk contains two hitherto unsuspected substances, now known as the water-soluble and fat-soluble vitamines, which will be referred to later, made it possible for us to become pioneers in the study of various problems relating to growth and maintenance. The field of study thus opened has been entered by numerous investigators here and abroad with results of far-reaching importance.

The experiments here to be described were made with albino rats because these small animals are omnivorous and can be fed with such quantities of the experimental rations as we are able to prepare in the laboratory in a state of purity. To insure perfect accuracy it is necessary that these rations shall consist of ingredients which are chemically pure and to prepare such rations in quantity is very laborious and costly. The results of these experiments can be accepted as giving evidence of the true food value of milk because they are in harmony with our experience in feeding not only ourselves but also farm animals.

The question may be asked—Are the results of experiments in

feeding rats, or other of the lower animals, applicable to human beings?

While the foods suited to different species of animals may differ widely in their appearance and physical properties, the digestible nutrients contained in them are very much alike in their chemical characters, so that by the processes of digestion quite similar products result from apparently very different kinds of food. Such differences as exist are rather in proportion than in kind. Furthermore, the tissues of the different types of animals are chemically even more alike than their foods and, consequently, their nutritive requirements are in principle much more nearly the same than those unfamiliar with the chemistry of nutrition would suppose.

The conditions in feeding farm animals are necessarily so complex that it is generally impossible to recognize the influence of any individual constituent of the ration. In our experiments with rats, on the contrary, the conditions have been so simplified that definite conclusions can be drawn regarding the rôle of each factor involved. Thus, if two series of animals are fed on mixtures of protein, fat, carbohydrate and inorganic salts, which are identical except for the kind of protein used, and one series grows normally whereas the other fails to grow at all, it is obvious that the protein alone was the determining element in the food. By means of large numbers of such experiments extending over a period of several years, we have fixed the nutritive values of many proteins, several fats, the various inorganic salts and also have studied a number of combinations of natural food products both of animal and vegetable origin which are extensively used in the daily rations of man or domestic animals.

The Proteins of Milk.

Previous to 1912 a discussion of the nutritive value of any food stuff would have been confined to a consideration of the total quantities of protein, fat, carbohydrate and salts which it contained and its value as a source of energy. As a result of work which has been done at this Station, and later in other laboratories, the field for discussion has become much broader, for it has been demonstrated that the *quality* of the protein present in any food is of even more importance than the *quantity,*

and a realization of the essential rôle which the so-called vitamines play in normal nutrition has raised many more problems.

Milk contains several different proteins, but there are only two which occur in notable quantity, and these are casein, the protein found in cheese, and lactalbumin, the principal protein of whey. These two proteins differ not only in their chemical structure, but also in their nutritive value. Both suffice to promote the normal growth of young rats, but lactalbumin is somewhat more efficient for growth than is casein, for in comparable periods of time a given quantity of lactalbumin will enable an animal to gain about 33 per cent. more in weight than the same amount of casein.

This is instructive from a practical standpoint for it demonstrates that the whey, obtained as a side product from the manufacture of cheese, contains one of the most valuable food proteins known and should not be wasted. Casein, which forms about 80 per cent. of the milk proteins, is more easily digested than any other protein known and behaves in the digestive tract very much like a predigested protein. This property makes it especially desirable as a food for infants or persons with weak digestions.

For centuries people have been accustomed to use foods of animal origin with bread and other cereal products which form so large a proportion of the average dietary. Bread and milk, eggs on toast, meat sandwiches and the use of milk on breakfast cereals are just a few illustrations of this custom. If any one who was enjoying a meal of any of these mixtures were asked why he chose the combination of the animal with the vegetable product instead of eating either one alone, he would probably say that "it tasted good," or "it satisfied his appetite better that way," or something else equally indefinite. It is only recently, while engaged in investigating the nutritive value of wheat flour, that we discovered how well the proteins of milk, eggs and meat supplement the deficiencies of the wheat proteins. We now have a truly scientific reason for this universal dietary practice.

If an animal is fed on wheat flour as the sole source of protein in an otherwise adequate ration, it will grow very slowly, if at all, even when relatively large amounts of the proteins are eaten. If, however, one-third of the wheat protein is replaced by an

equivalent quantity of protein in the form of milk, eggs, or meat, the animal will grow at a practically normal rate.

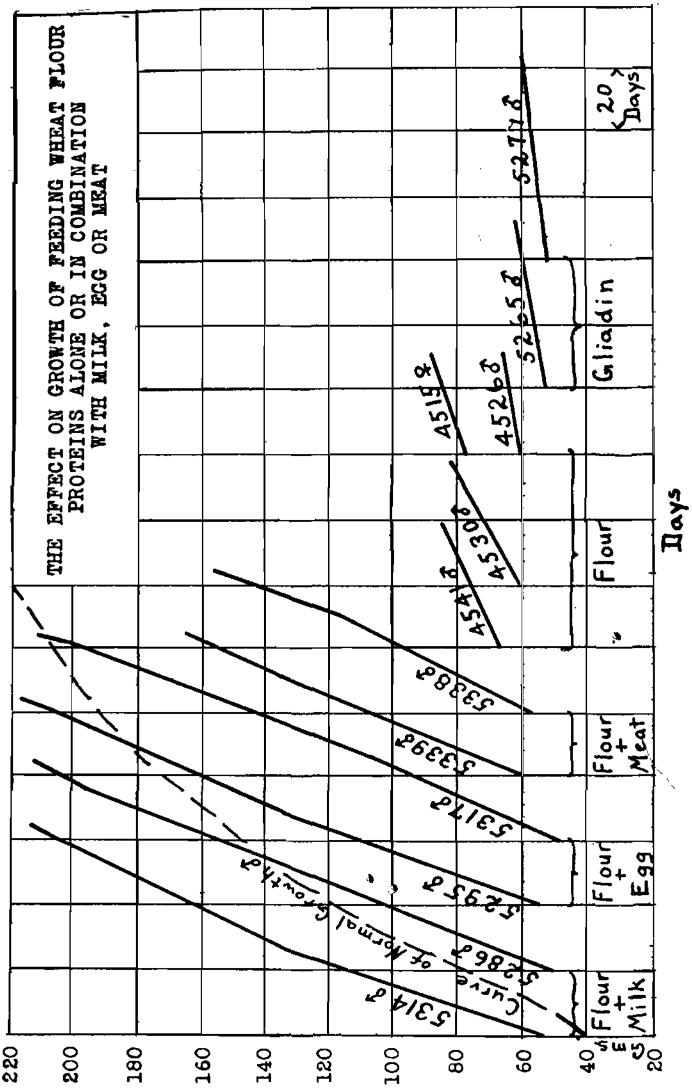


CHART I.

To illustrate this as well as the results of our other experiments with various diets of known composition, in a condensed form, we have employed charts giving the curves of body

weight during the time of feeding. In reading these charts the squares running horizontally represent time of feeding expressed in days, running vertically the weight of the animal in grams (1 gram equals about $^1/_{30}$ of an ounce). The heavy black lines show the rate at which the animal gained weight; the more nearly vertical these lines the more rapid the growth.

Chart I gives a graphic representation of the curves of growth of a number of rats which have been fed in these ways, and Figure 1 gives the photographs of two of these animals.

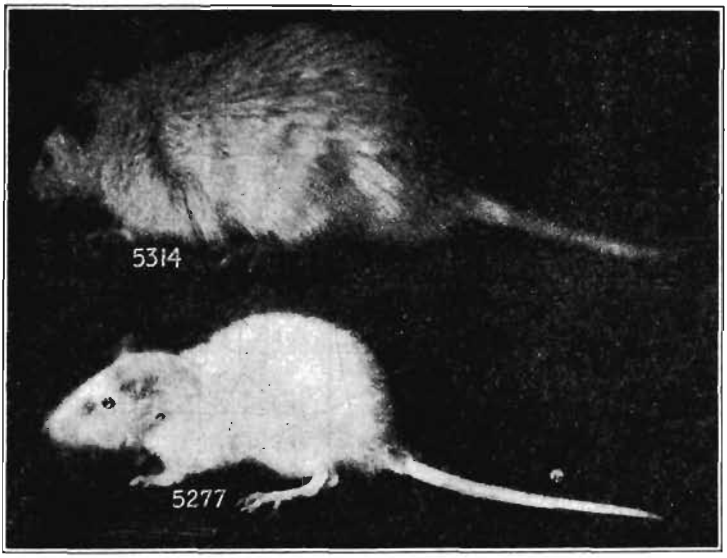


FIGURE 1

Rat 5277 was fed on a diet in which gliadin from wheat flour furnished the protein. On this food he gained only 10 grams in ten weeks. Rat 5314 was fed on a mixture of wheat flour and milk. On this food he gained 160 grams in nine weeks. This illustrates the importance of combining milk with the cereals instead of feeding the cereals alone.

All of the animals shown in this chart were of the same size and age, and were growing vigorously when put on the experimental diets. The differences in size at the end of each experiment are due solely to the protein of the diet. In this series of experiments the percentage of protein and nutritive ratio of the mixtures were practically identical, the foods differing only in

the kind of protein. The animals in the group labelled "flour" received all of their protein from wheat flour, those in the groups labelled "flour + milk," "flour + egg," and "flour + meat" received a diet whose concentration of protein was the same as that of the "flour" group, but one-third of the protein was furnished by milk, egg, or meat respectively, the remaining two-thirds being furnished by flour. It is obvious that relatively small quantities of these animal proteins greatly improved the value of the food for growth. The value of these animal products lies in the fact that they are chemically so constituted as to supplement the chemical deficiencies of the flour proteins. To those who are unfamiliar with the chemistry of proteins this may seem mysterious and confusing, hence a few words of explanation are necessary.

By digestion the proteins are broken up into the amino-acids already mentioned on page 5, which are then used in constructing the new proteins of the tissues of the growing animal. Unless the food protein furnishes a sufficient amount of each of these amino-acids which are needed to make the tissues required for normal growth the animal grows correspondingly slower than it would if more of the needed amino-acid were available.

Wheat flour contains two proteins, one of which, called gliadin, yields only a very small amount of the amino-acid called lysine. The effect of a limited supply of lysine on growth is illustrated by rats 5277 and 5265, whose curves of body weight are shown in Chart 1. These were fed on a diet in which all of the protein was furnished by gliadin. They have been maintained in good health, but have gained only about 10 grams.

The rats on the "flour" diets grew somewhat more than those on the gliadin food because flour contains another protein which yields more lysine than does gliadin and hence supplements to some extent this deficiency of the gliadin. However, the amount of lysine thus supplied was too little to promote normal growth. In this connection it is interesting to note how perfectly a young animal can be maintained in health, but without growing even for a very long time when its diet is adequate in respect to everything except the chemical constitution of its food protein. Such animals can be thus kept as infants for indefinite periods.

Chart II shows how little growth was made during nine months on a diet in which gliadin from wheat flour furnished all the protein. At the end of these nine months the rat was given a similar diet containing enough dried milk to replace the gliadin,

FIGURE 2

Figure 2 shows the contrast between feeding a good or a bad protein to a young rat. The two upper rats are five months old and have been fed on diets exactly alike except the one at the top had casein from milk on which it grew normally, and the one in the middle had gliadin from wheat flour on which it could not grow at all, so that when it was five months old it weighed exactly the same as the rat at the bottom which was only one month old.

and in two weeks on that food it gained as much in body weight as it had during the preceding nine months. It continued to grow normally on the milk diet to full adult size; a striking illustration of the value of milk proteins for growth. If, instead

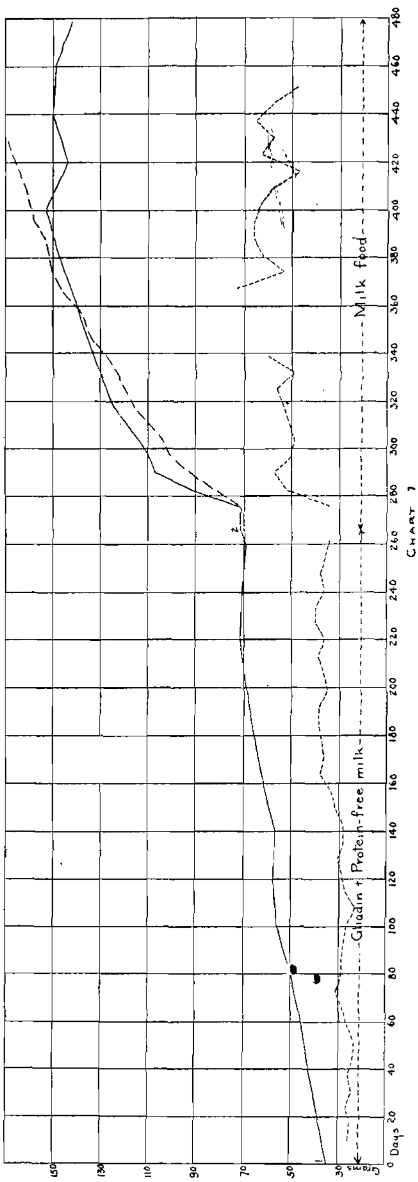


CHART II.

The solid line in Chart II shows the body weight of a rat which was fed for about nine months from the time of weaning on a diet containing gliadin from wheat flour as the sole source of protein. After 268 days, as indicated by the figure 2, the proteins of milk replaced the gliadin. Growth soon began at a normal rate for the size of the rat, which is shown by the broken line. The dotted line below shows the amount of food eaten during the experiment.

of replacing the gliadin with milk, we had added to the gliadin food a small amount of lysine, the effect would have been the same.

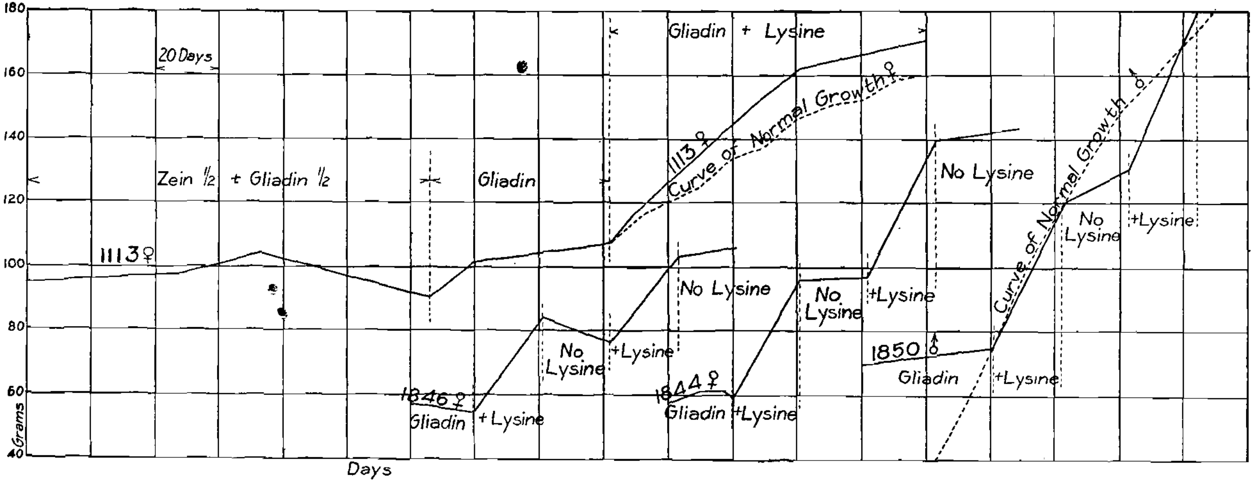


CHART III.

Chart III shows the failure of young rats to grow when gliadin from wheat flour is the sole source of the protein in the diet. When a little of the amino-acid lysine was added the rate of growth became normal. Cereal proteins yield little lysine, milk proteins yield much. This explains why combinations of cereals with milk are superior to cereals alone as food for the young.

Chart III shows the weight curves of several rats whose growth was alternately stimulated or checked by the addition to a gliadin diet of very small quantities of lysine or by its removal.

In every day practice, however, it is impossible to feed lysine, as such, and therefore the problem resolves itself into finding available proteins which are sufficiently rich in lysine to be capable of supplementing this deficiency of the flour proteins. The two foods which thus far have proved to be the most efficient supplements to flour are milk and eggs; either of these is somewhat better than meat. Thus under similar conditions of feeding when the food contains two parts of flour proteins to one part of meat protein rats gain about three times as much per unit of protein eaten as when flour furnishes all the protein, and nearly four times as much when milk or eggs are used as supplements.

The same is true for corn supplements. Zein, the principal protein of corn, lacks two essential amino-acids, tryptophane and lysine, hence when zein furnishes all of the protein of the diet, the animal loses weight rapidly and dies almost as soon as if no food were eaten. When a small quantity of one of these missing amino-acids, tryptophane, is added to the zein diet, the animal maintains its weight and lives for a long time but does not grow. If in addition to tryptophane, lysine also is added, the animal grows.

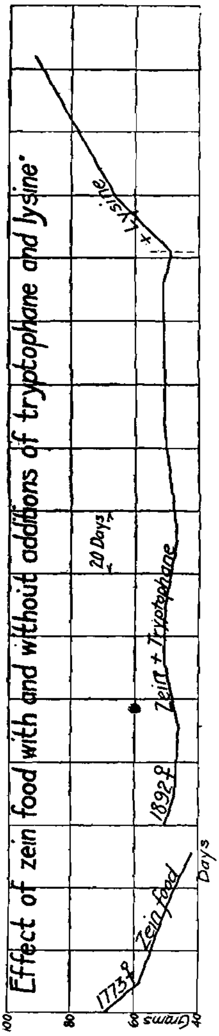


CHART IV.

Chart IV *shows the important part played* by amino-acids *in nutrition*. Zein, which forms about one-half the *protein of* corn meal, lacks two of these, known as *tryptophane and* lysine. Unless tryptophane is added *to* a diet containing zein as its sole source of protein, life cannot long be maintained. Unless lysine is also added, growth is impossible. The proteins of milk contain an abundance of both of these amino-acids.

Chart IV shows the curves of body weight of rats receiving zein alone as well as zein in combination with tryptophane or with tryptophane and lysine. Note that the body weight of one of these rats remained constant for six months when the diet contained zein and tryptophane. When small amounts of both lysine and tryptophane were added to the zein food the rat grew.

Figure 3 shows in a striking manner how essential it is to supply the young animal with protein which furnishes sufficient lysine. The lower picture is that of a young rat which lived for seven months in perfect health on a food containing zein + tryptophane as its sole protein. During all of this time it failed to grow and weighed only 70 grams. It did not even show signs

FIGURE 3.

The lower photograph is that of a rat which has been fed for seven months on a diet containing zein (one of the proteins from corn) + a small amount of amino-acid tryptophane. On this diet the rat could live but could not grow. The upper photograph is one of the same animal taken a few months later, after casein from milk had replaced the zein and tryptophane.

of maturing for, as you can see, it looks exactly like a recently weaned rat; it has remained a baby. At the end of seven months casein was used to replace the zein + tryptophane. No other change was made in the diet. During the next three months it grew at the normal rate to 230 grams, and as the upper picture shows, became a fine, vigorous animal.

What this means might be illustrated in this way. For about one-fifth of its life period the rat did not grow. Calling a man's span of life seventy years the case would be somewhat like that of a boy, kept as a healthy infant in arms until fourteen years old—weighing perhaps sixteen to twenty pounds—and who, by a change of diet when fourteen years old, attained a man's size and weight at the age of twenty-one.

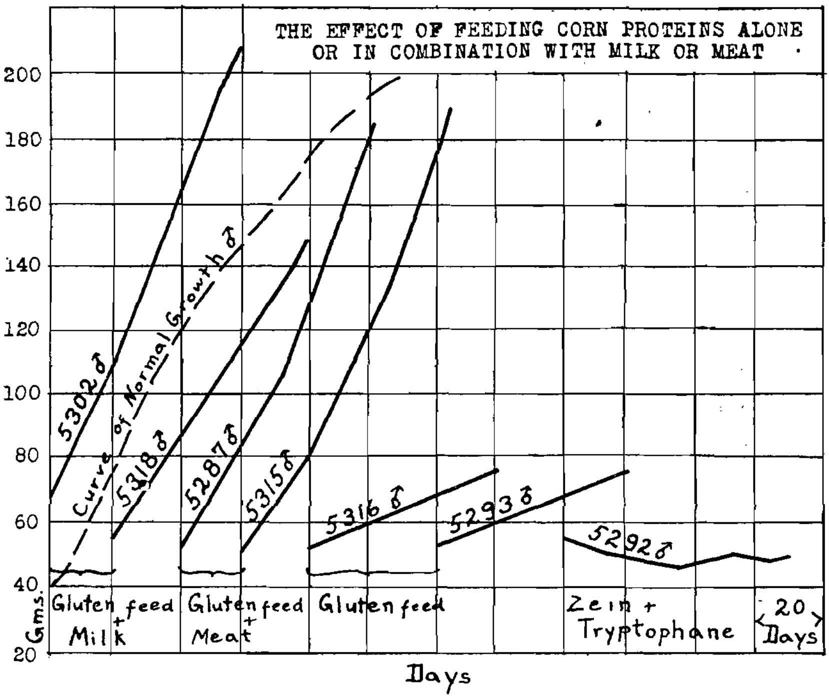


CHART V.

Two of the rats, 5293 and 5316, whose curves of body weight are shown in Chart V, had a ration in which the protein was furnished by gluten feed. Rats 5302, 5318, 5287 and 5315 on the other hand had two-thirds of their protein in the form of gluten feed and the other third as milk or meat. The nutritive ratios of all of these three foods were alike, but the results were strikingly different.

This juggling with proteins and amino-acids is very interesting to the chemist and physiologist for it represents a triumph of science which excites the wonder of those who appreciate the

almost insurmountable difficulties encountered in these investigations. It would be of little use to discuss it here, if these facts could not be applied to the feeding problems of the household and farm. Amino-acids are not commercially obtainable but products are at hand which contain proteins which furnish these

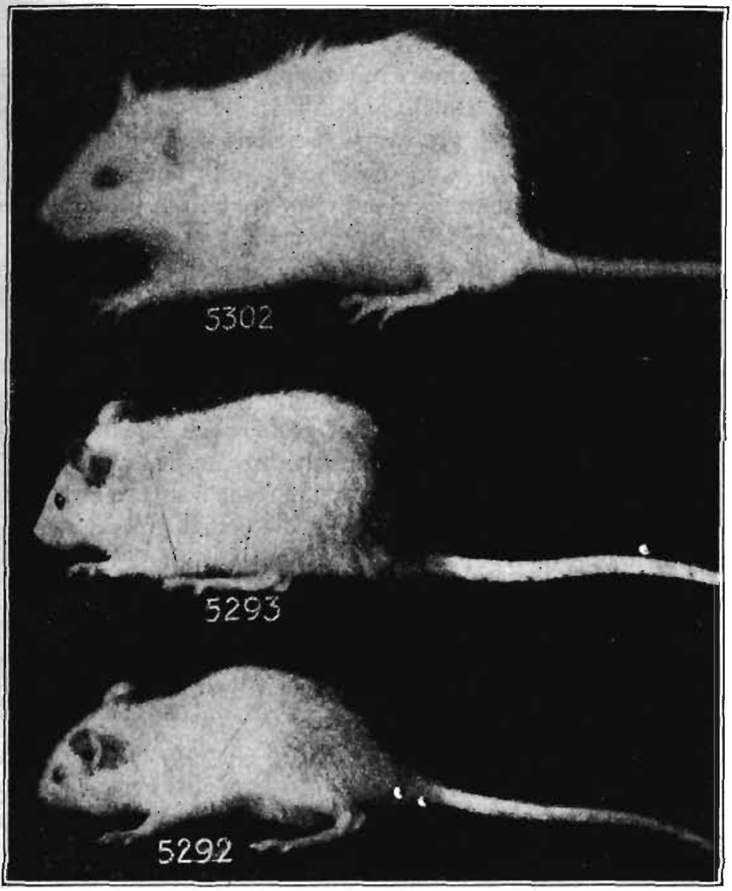


FIGURE 4

Figure 4 shows photographs of some of the animals whose curves of body weight are shown in Chart V. Although all three were of the same age, Rat 5302 which had received a mixture of gluten feed and milk is nearly three times as large as 5293 which received the gluten feed alone and more than four times as large as 5292 which was fed on zein plus tryptophane.

amino-acids in readily obtainable form. Now let us see how we can apply these facts.

When corn as a whole is fed, the other proteins in this seed supplement the zein to such an extent that the animal can grow slowly, but if the corn is combined with milk, the proteins of which are rich in both tryptophane and lycine, growth is very rapid.

Thus it appears that the chemical constitution of the protein of the food influences growth and that it is absolutely necessary to provide animals with protein of the right kind, if they are to grow well. This applies not only to growth, but also to milk or egg production. Both milk and eggs are rich in protein. The animals producing them need large amounts of protein in their food, but until the differences in the chemical constitution of the proteins of different feeds were discovered, it was not appreciated how important it is to provide protein of the right kind. This fact has been unconsciously recognized by milk producers for they always feed protein from several sources. This practice is an attempt to furnish a mixture of proteins which will mutually supplement each other, but whether the mixtures now in general use are yielding the best results at the least cost remains to be determined. As yet we do not know the actual protein requirements of milk production. Are these similar to those of growth? This problem remains for future study.

That a proper combination of proteins may mean much in the way of profits when growing animals are fed is illustrated by the following from a bulletin recently issued by the Ohio Agricultural Experiment Station. In a series of experiments, comparing the value of corn alone with combinations of corn and tankage, or corn and skim milk, it was shown that a bushel of corn fed alone produced only nine pounds of gain. The same quantity of corn fed in combination with 5.5 pounds of tankage produced 13.3 pounds of gain, and corn fed with 168 pounds of skim milk, equal to 17 pounds of dry food, increased the gain to 21.8 pounds per bushel of corn fed. In other words, each ten pounds of the dry matter in the skim milk replaced 54.9 pounds of corn. Expressing these results in terms of dollars and cents, corn alone produced pork at a loss of $8.38 per 100 pounds of gain, whereas nine parts of corn fed with one part of tankage produced pork at a profit of $14.91 per 100 pounds of gain, and

one part of corn fed with three parts of skim milk yielded a profit of $35.59 per 100 pounds of gain.

The Vitamines of Milk.

Another constituent of milk which has a unique value in the dietary is the butter fat. If a young rat is fed on a ration adequate in all respects except that the fat is furnished by lard, or vegetable oils like olive oil, it will grow normally for a period of about 80 days, then suddenly it declines in weight and soon

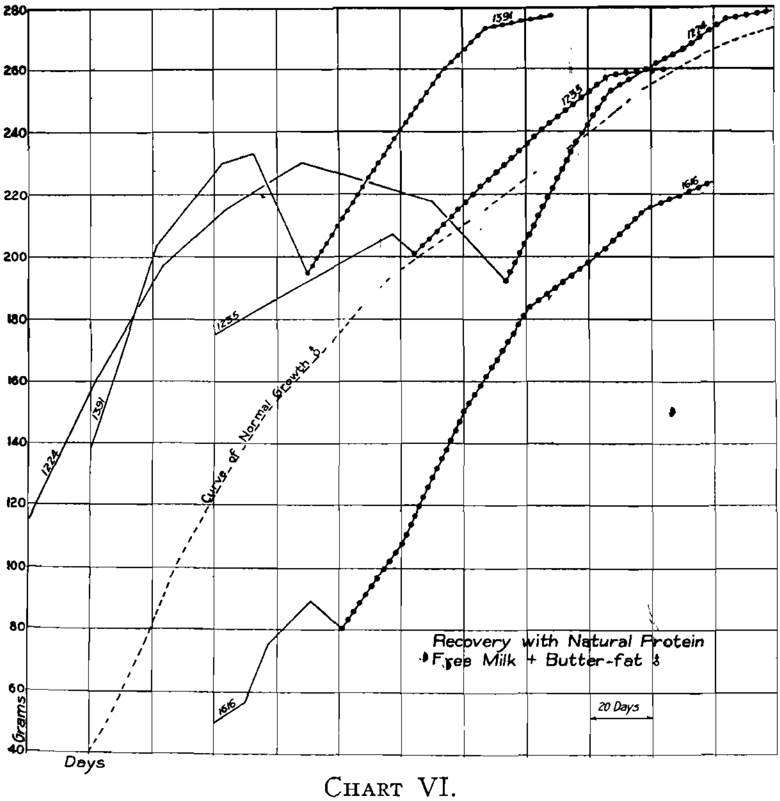


Chart VI.

Chart VI shows that butter fat contains something essential for normal growth. These curves show that after feeding a diet of purified foodstuffs, the fat being lard, the animals after growing normally for several weeks suddenly began to lose weight. When a part of the lard was replaced by butter fat (shown by the beaded line), they immediately recovered. These animals would have died in a few days if this change had not been made.

dies. Such animals frequently suffer from sore eyes and in many cases develop large ulcers on the eyeball. A small amount of butter fat added to the diet causes an immediate recovery of health, gain in weight and prompt restoration of the eyes to their normal condition. This marvellous effect is due to the presence in the butter fat of something of, as yet, unknown nature, which for the time being is called the fat-soluble vitamine. The presence or absence of this substance in any foodstuff can be detected only by feeding young animals.

Chart VI shows the weight curves of rats which declined on a diet in which lard was the sole fat component and then rapidly recovered when part of the lard was replaced by butter fat.

Recently it has been reported from some parts of Europe that many children have been afflicted with a disease called xerophthalmia, which is characterized by the development of ulcers on the eyeball.

Figure 5 shows a photograph of a child thus affected. This condition is strikingly like that exhibited by rats fed on rations deficient in the butter-fat vitamine, and is probably due to the same cause, for these xerophthalmic children who had been fed almost entirely on skim milk and cereals were promptly cured by whole milk or cod liver oil. It is still unproved that this butter fat vitamine is essential for adults. We have maintained mature rats for many months in good condition on diets containing no known source of this substance, and as yet they have shown no signs of malnutrition. For the normal growth and development of the young, however, it is absolutely essential.*

Just what these vitamines are has not been discovered yet, but at least three types exist, namely the fat-soluble or "A" vitamine; the water-soluble, "B," and the antiscorbutic, "C" vitamine. Milk contains some of the antiscorbutic vitamine

* It is worth noting that Dr. H. C. Wells, who had charge of the distribution of food in Rumania for the American Red Cross, tells us he made successful application of our observation that cod liver oil contains much of the fat-soluble vitamine.

A cargo of cod liver oil at Archangel having been offered to him he immediately ordered it sent to Rumania hoping by its use to save the eyesight of thousands of children whose eyes were in the same condition as those of rats fed on a diet deficient in the fat-soluble vitamine. By giving this cod liver oil to these children a large majority were saved from permanent blindness, even after their eyeballs had become entirely opaque.

which prevents scurvy, though less than do some of the vegetable and fruit juices, notably orange juice. This vitamine is sensitive to heat, hence children fed on pasteurized or boiled milk are more susceptible to infantile scurvy than are those fed on unheated milk, unless the scurvy-preventing vitamine is given them in some fruit or vegetable juice in which it is abundant.

The relation of the fat-soluble vitamine to nutrition, and its presence in butter fat have already been discussed at considerable

FIGURE 5

This child was fed on skim milk, and as a result an ulcer developed on one eyeball. This was because it did not get any of the so-called fat-soluble vitamine which is present in the butter fat. Plenty of cream, butter, or cod liver oil will cure this child's eye. Young rats develop this same disease when fed on diets free from the fat-soluble vitamine and are promptly cured by adding a little butter to their diet. (Photograph from Bloch, C. E., Ugeskrift for Laeger, Mar. 8, 1917, **79**, 309, 349.)

length. It is only necessary to add that this vitamine is quite resistant to heat, for we have passed live steam through melted butter fat for two and one-half hours without destroying its potency.

The third type of vitamine, known as the water-soluble vitamine, is also present in milk. Without an adequate supply of

this food accessory in the diet, life cannot be maintained. An animal which is fed on a ration containing no known source of this vitamine dies within a short time. If, however, when apparently dying, a very little of this food accessory is given, it recovers with surprising rapidity. This may be given in the form of milk, yeast, commercial wheat embryo, or any other natural foodstuffs.

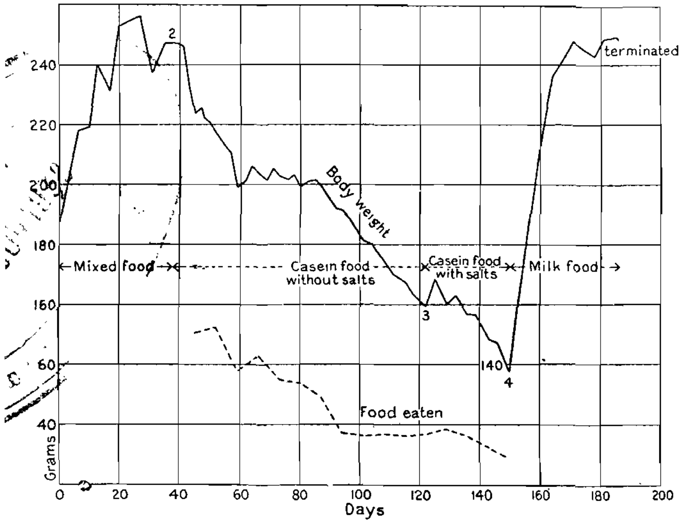


CHART VII.

Chart VII illustrates the typical recovery (in Period 4) of a rat which had declined on a diet lacking the so-called water-soluble vitamine (Periods 2 and 3), when the animal was given milk which contains this vitamine. This rat would have been dead in a few days if the milk had not been given.

Chart VII shows the rapid decline in weight typical of feeding a food deficient in the water-soluble vitamine. It also shows the effect of feeding an abundance of dried milk as a source of this vitamine.

That the water-soluble vitamine is something apart from and independent of the fat or protein of the milk is shown by the results of our experiments. For many years we used the product obtained by evaporating to dryness milk freed from fat and protein as a source of the water-soluble vitamine in the diets fed to our experimental animals.

Chart VIII shows that this product which we have called "protein-free milk" is just as efficient as a source of water-soluble vitamine as is the whole milk. Contrary to what appears to be generally believed, the water-soluble vitamine is resistant to heat. "Protein-free milk" prepared by evaporating at a temperature not far below that of boiling water is just as efficient

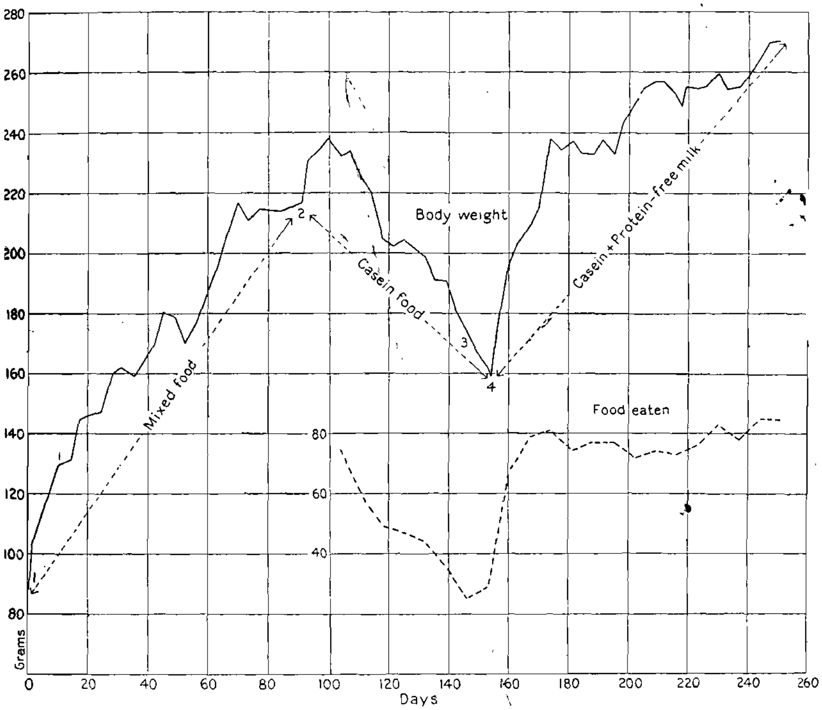


CHART VIII.

Chart VIII is a further illustration of the necessity of an abundance of the water-soluble vitamine in the food, if the animal is to live. In Period 1 the animal grew normally on an ordinary mixed diet. In Period 2, on a diet adequate, except for the lack of this vitamine, it declined rapidly and would soon have died if some source of this vitamine such as protein-free milk (milk freed from fat and protein) had not been fed (Period 3). The protein-free milk contains not only the salts and the lactose of the milk but also the water-soluble vitamine. On the casein diet the weekly food intake (shown by the dotted line at the bottom) declined steadily from nearly 80 grams to a little over 20 grams, but rose immediately to about 80 grams when the protein-free milk (water-soluble vitamine) was given.

as a source of vitamine as is an equivalent quantity of fresh, unheated milk. Even boiling for several hours does not destroy this vitamine.

By what means this vitamine exerts its marvellously beneficial influence is still unknown. The rapid gains in weight following its use are always accompanied by a very great increase in the

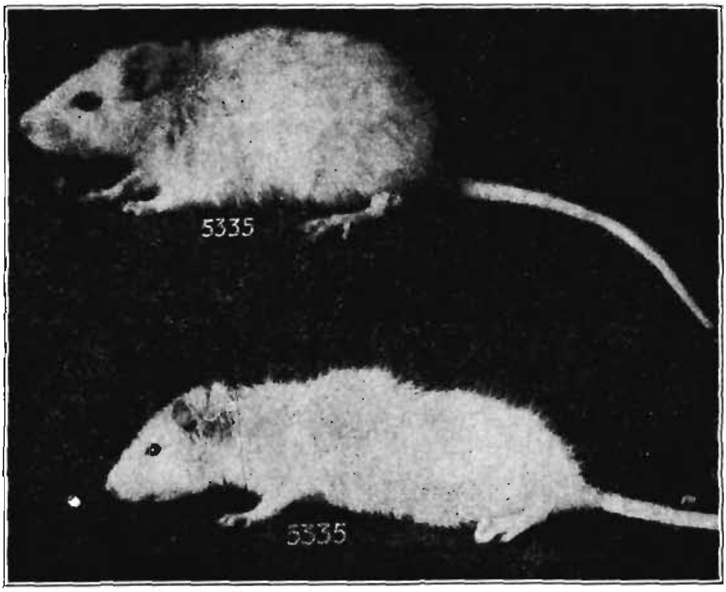


FIGURE 6.

The lower picture shows a rat which had been fed for one month on a diet deficient in water-soluble vitamine. At this time the animal was so weak it was scarcely able to stand and would have died in a few hours if some source of this vitamine had not been furnished. After the picture was taken a small daily dose of yeast which is very rich in the water-soluble vitamine was given to the rat, the food remaining otherwise exactly as before. Twelve days later the upper picture was taken. The result is apparent.

amount of food eaten, the weekly food intake frequently being doubled and sometimes even quadrupled when a small amount of vitamine-containing food is given to an animal declining on a food free from water-soluble vitamine. The vitamine may act simply as a stimulant to a jaded appetite, and the better growth may be

due solely to the increased food intake; or it may supply one or more essential factors needed to complete an inadequate diet, and the effect of adding the vitamine may be analogous to that obtained by adding a missing amino-acid, or a sufficient supply of some inorganic element which was present in too small an amount to permit of normal nutrition. When we know more about the chemical nature of the vitamines, we may be able to discover just what part they take in the processes of nutrition.

Professor Hopkins of England reported some experiments in which he obtained very striking results by feeding daily small quantities of fresh milk to rats which were on a diet supposedly free from water-soluble vitamine. From his data the conclusion was drawn that milk is very rich in this type of food accessory. In some recent attempts to duplicate his results, we found it necessary to use much larger quantities of milk than he did in order to get comparable results.

Undiluted milk contains all the vitamine necessary for the young animal, but in feeding babies it is the practice to dilute cow's milk with water and to reinforce the mixture with milk sugar. By this procedure the vitamine content of the original milk is so far reduced that the bottle-fed baby may get enough of this essential food factor only when it takes a liberal quantity of the food. Whenever appetite fails, the food intake and consequently the vitamine intake are reduced. The effect of this is to further reduce the appetite because the amount of food eaten depends on the vitamine content of the diet. It is thus evident that under such circumstances the child goes from bad to worse and the endless troubles so familiar to mothers ensue.*

In feeding young animals trouble is rarely encountered when

*In this connection it is interesting that Dr. Amy L. Daniels and Dr. Albert H. Byfield have just published in the American Journal of Diseases of Children a report of their experience with additions of the water-soluble vitamine to the milk diets of bottle-fed babes. These experiments were founded on our discovery that milk contains less water-soluble vitamine than had been previously supposed. In each case there was a marked increase in the rate of growth of the infant when the additional vitamine was given and a slowing of the rate when it was omitted. From these experiments it appears that the standard milk mixtures, used for feeding infants, furnish too little of the water-soluble vitamine even when consumed in normal amounts.

the food is right. On the other hand very slight defects in the food lead to countless difficulties.

The Sugar of Milk.

At present we do not know whether or not milk sugar has any greater value for nutrition than have other carbohydrates. It has been thought that liberal quantities of milk sugar in the diet produce lactic acid in the intestine and thus transform the bacterial flora from a type which produces putrefaction to one which checks this process. None of the other kinds of carbohydrates tested has this effect, but to what extent this change is advantageous to the body is as yet undecided.

The Mineral Matters of Milk.

Milk also holds a valuable place in the average dietary, on account of the composition of its mineral constituents. Cereal foods contain relatively little calcium, sodium or chlorine, hence animals are unable to grow on diets composed solely of cereals unless these inorganic deficiencies are supplemented. Milk, on the other hand, is rich in calcium, for it contains about three times as much as does the entire wheat grain, and about six times as much as does corn meal. The presence of an abundant supply of calcium in the food is essential, for it not only contributes to the maintenance of the proper neutrality of the body fluids, but is needed to form strong and well-developed skeletons. A liberal consumption of milk by growing children is, therefore, desirable as a "factor of safety" against deficiencies in the mineral nutrients of the other constituents of the dietary.

The Cost and Economy of Milk.

Now let us consider the cost of this exceptionally valuable food as compared with other common foods and see how much truth there is in the statement that its cost makes its free use prohibitive to all but a few.

It is difficult to put an exact value on a complicated product like milk, but a fair estimate of its relative value compared with other food products can be reached by calculating the cost of the several types of food elements in milk and other staple products. Milk sugar has the same food value as cane sugar. We can

buy a pound of the latter for 11 cents, so we may assign this value to the sugar in milk. Milk fat has a higher value than have ordinary food fats as shown by the higher price of butter, but let us assume that in milk, fat is worth no more than lard, say about 35 cents a pound.

One hundred pounds of average milk contain about 12.5 pounds of solids of which five pounds is sugar, worth 55 cents at 11 cents a pound, and four pounds of fat worth $1.40 at 35 cents a pound, or $1.95 for the fat and sugar. One hundred pounds of milk contain 46½ quarts, which at 16 cents a quart is $7.45. Subtracting $1.95 from $7.45 leaves $5.50 for the 3.3 pounds of dry protein in the one hundred pounds of milk, or $1.67 per pound.

Now, how much does dry protein cost in meat or eggs? One hundred pounds of lean round of beef contain 7.3 pounds of fat worth $2.55. Subtracting this from $50, which one hundred pounds of this cut of beef now costs at retail, leaves $47.45 for 19.5 pounds of dry protein, or $2.43 a pound; 76 cents a pound more than milk protein. The difference is even greater for eggs, for by the same method of calculating, in storage eggs at 55 cents a dozen protein costs $2.64 a pound, or 97 cents a pound more than milk protein. According to this method of calculation only when the lean round of beef sells for 35 cents a pound and eggs sell for 35 cents a dozen are they as cheap sources of protein as is milk at 16 cents a quart. Thirty-five cents spent for milk at the present price buys nearly as much protein, about two and one-half times as much fat and more than twice as much energy as is contained in a pound of lean Hamburg steak. In buying milk, moreover, one is procuring protein of exceptional value because it enhances the nutritive value of our cereal foods. In addition one is obtaining a liberal supply of vitamines, whose value cannot be estimated in dollars and cents, for as yet we have no adequate knowledge regarding their relative abundance in different foods.

Since milk is so vitally essential as a food for growing children and is such a valuable supplement to a diet composed largely of cereals, vegetables, meat, sugar and fats, the production of milk should be stimulated so that there may be an abundance of milk and milk products of the highest possible grade at prices which shall put them within the reach of all.

Summary.

Milk is absolutely essential for the life of infants and very young children.

It is a most desirable adjunct to the diet of older, rapidly growing children.

It is the main dietary reliance in cases of disordered digestion or extreme illness.

Milk contains an abundance of protein, fat, carbohydrate and mineral nutrients, and its proteins are not only of superior value when used alone, but they are especially adapted to supplement the protein deficiencies of the cereals which form so large a part of the daily ration of mankind. Its mineral nutrients also supplement the deficiencies of the cereals, meat, sugar and fats in these important elements. Moreover it contains the three vitamines without which life cannot be maintained.

The scurvy-preventing vitamine is destroyed by heat and therefore if infants are fed on pasteurized or sterilized milk the use of orange juice or some vegetable extract is necessary to avoid the possibility of scurvy.

Whole milk contains enough water-soluble vitamine to meet an infant's requirements, but if "the top of the bottle" diluted with water is fed, the supply of this essential vitamine may be insufficient unless it is supplemented from some other source.

Milk is the only food known which is capable of serving as the sole constituent of an adequate ration.

Milk is a cheaper form of food at 16 cents a quart than either beef at 35 cents a pound or eggs at 35 cents a dozen.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

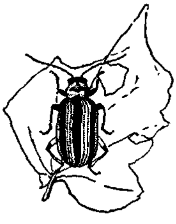
NEW HAVEN, CONN.

BULLETIN 216 DECEMBER, 1919

ENTOMOLOGICAL SERIES, No. 27.

INSECTS ATTACKING SQUASH, CUCUMBER, AND ALLIED PLANTS IN CONNECTICUT.

By W. E. Britton.



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December, 1919.

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Insects Attacking Squash, Cucumber and Allied Plants in Connecticut.

By W. E. Britton, *Entomologist.*

A paper on this subject was published in the report of this Station for 1908, page 805, but it has long been out of print. The present paper follows the plan of the earlier one, but has been revised, enlarged, and wholly rewritten, and is published in this form so that the information can be placed in the hands of truck crop growers throughout the state.

For the past five years, cucurbitaceous plants have been grown each year at the Station farm at Mount Carmel for the purpose of studying the insects attacking them and methods of control. Consequently this paper is more than a compilation, and embodies the results of our own experiments and experience.

Cucumbers, squashes, pumpkins and melons are grown rather extensively in Connecticut, and are attacked and often severely injured by a number of insect pests. For the hasty identification of these insects the reader is referred to the following key revised from the earlier paper mentioned above:—

KEY TO INSECTS OF SQUASHES, PUMPKINS, CUCUMBERS AND MELONS.

	PAGE
Boring in the roots and stem—	
Small, slender larvae tunneling in the main root or stem below ground	
Striped cucumber beetle, *Diabrotica vittata*	34
Large, stout larvae boring in squash stems above ground	
Squash vine borer, *Melittia satyriniformis*	39
Devouring the stem and leaves—	
Small (1.2 mm.) purplish jumping springtails	
The garden flea or springtail, *Sminthurus hortensis*	37
(2 mm.) black jumping beetles feeding upon the young leaves	
Cucumber flea beetle, *Epitrix cucumeris*	38
Larger (5-7 mm.) yellowish beetles feeding upon the leaves.	
Body yellow, marked with three longitudinal black stripes	
Striped cucumber beetle, *Diabrotica vittata*	34
Body greenish yellow, marked with twelve black spots	
Twelve-spotted cucumber beetle, *Diabrotica xii-punctata*	37
Large (8-10 mm.) hemispherical beetle, orange, marked with black spots, or yellow larva with black spines	
Squash lady-beetle, *Epilachna borealis*	42

Sucking sap from the under side of the leaves—

Small dark green or brownish plant lice, often very abundant
Melon aphid *Aphis gossypii* 47

Larger bright green plant lice usually not abundant
Squash aphid, *Macrosiphum cucurbitae* 49

Grayish-brown bug with spicy odor (15 mm. when full-grown)
Squash bug, *Anasa tristis* 44

Small greenish-white scale-like insects on the under leaf surface of plants growing under glass or near greenhouses. Pure-white moth-like adults resting on the leaves, and flying about
Greenhouse white-fly, *Asterochiton vaporariorum* 50

CHEWING INSECTS.

The Striped Cucumber Beetle.

Diabrotica vittata Fabr.

As soon as the plants appear above the surface of the ground, and sometimes before, they are attacked as shown on plate I, c, by small beetles, striped lengthwise with yellow and black. These

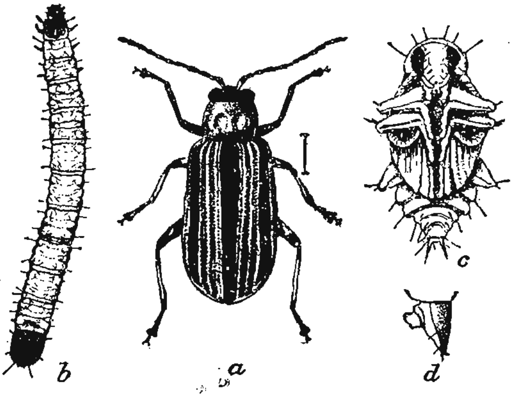

Figure 7. The striped cucumber beetle: *a*, adult beetle; *b*, larva; *c*, pupa; *d*, side view of anal segment. All greatly enlarged. (After Chittenden, Circular 31, Bureau of Entomology, U. S. Department of Agriculture.)

beetles eat away the tender tissue of seed leaves and young stems, often killing the plants unless treatment is given. They are about one-fifth of an inch (5 mm.) in length, with thorax and wing-covers yellow, with head and three longitudinal stripes, black. See figure 7, and plate I, b.

At the time the beetles are feeding they are also mating and the females lay eggs around the stem, just below the surface of the ground. These eggs are shown on plate I, a. The larvae hatching from them are slender whitish grubs with black heads, which tunnel in the roots or main stem in the ground, sometimes causing considerable injury, as shown on plate II, though probably this injury is less than that caused by the adults. The tunnels afford entrance for the wilt diseases which are often serious. The white pupa stage lasts about a week and occurs in the ground. There are two generations each year in the South, but only one in Connecticut, and the winter is passed by the adult beetles in the ground. Late in the summer the beetles are often abundant and feed upon the flowers of squashes and cucumbers and also upon goldenrod and other native flowers. They are often found resting in the curled leaves of the old vines.

One parasite, a Tachinid fly, *Celatoria diabroticae* Shimer, has been reared from the striped cucumber beetle in California and Texas.

METHODS OF CONTROL.

Control methods in vogue against this insect may be classified as follows:—

(1) Cultural practices.
(2) Covering the plants.
(3) Applying poisons or repellents.

(1) Cultural practices consist of crop rotation, the use of quick-acting fertilizers to force plant growth, plowing, destroying old vines, time of planting, and the use of trap crops. Some of these need no explanation. It is advisable where possible, to plant the seeds in berry baskets or paper pots under glass and set them in the field when they are five or six inches tall as they are not so liable to be destroyed. Deep plowing in the spring will expose many hibernating adults which may be killed before they have a chance to attack the vines. As soon as the crop has been harvested in the fall, the vines should be gathered and burned to kill the insects resting on them. A light harrowing of the ground immediately afterwards will kill many of them.

Trap crops of squash or beans may be planted early around the field to attract the beetles. These can then be poisoned and

many of the beetles will be killed before the regular crop is ready to be attacked.

(2) The hills may be covered with plant protectors of wire cloth or cheese cloth to keep the beetles away from the plants. Cloth covered protectors are for sale on the market, or may be made at home by cutting a barrel hoop in two equal parts and fastening the centers of the two pieces together at right angles, setting the ends in the ground and covering with cheese cloth or mosquito netting. Still better, fasten the ends of the semicircular pieces to another hoop lying horizontally and cover the whole with netting to make a portable frame protector. As soon as the plants fill the protectors, the protectors may be removed and stored, for the following season. The cloth will usually last about two years, possibly three, then the frames will need recovering. It is often necessary to mend or patch the netting when small holes get torn in it. Boxes and various other forms of wood and netting may be adapted for service as plant protectors, but they are for use in the home gardens.

All forms of plant protectors must be placed over the hills before the beetles appear. Factory-made protectors are shown on plate III, c.

(3) Most commercial growers apply poison to the young plants as a protection. Lead arsenate is perhaps the best for this purpose, and it may be used as a spray or as a dry powder. The beetles do not like to come out of the ground through a layer of dry powder, and a heavy application of dry arsenate of lead is usually effective. If the plants are sprayed, it is essential that the under surface of the leaves be coated or the beetles will congregate there and eat away the substance of the plant. Where cucumbers are grown, it is advisable to spray them with Bordeaux mixture to which lead arsenate may be added at the rate of two ounces of the paste or one ounce of the dry powder to one gallon of the liquid.

Various other dry powders, such as air-slaked lime, gypsum or land plaster, and soot, freely dusted upon and around the plants are of considerable value in controlling the striped cucumber beetle.

The Twelve-Spotted Cucumber Beetle, or Southern Corn Root Worm.

Diabrotica xii-punctata Oliv.

Though having a long list of food plants, including nearly all of the common vegetables, and not usually considered as a particular pest of cucurbitaceous plants, it has been so abundant in certain fields in some seasons that considerable damage must have resulted from it. In the South, the larvae are a serious pest of corn roots, and it is called the corn root worm. It also attacks rye, millet, and garden beans, often doing considerable damage.

The adult beetle shown on plate III, a, is somewhat larger and stouter than the striped cucumber beetle, and averages about 7 mm. in length. The wing-covers are greenish-yellow, marked with twelve black spots varying in size and arranged in three transverse rows. The thorax is bright yellow and the head black. The legs, except basal half of thighs, and the antennae are blackish; basal half of thighs greenish-yellow.

The life history is similar to that of the striped beetle, each female laying two or three hundred eggs in the soil. These eggs hatch in from one to three weeks, and the larvae tunnel in the roots of corn and other plants, becoming mature in from two to five weeks: then they pupate in earthen cells in the ground, the beetles emerging a week or two later.

When abundant this insect can be controlled in the same manner as the striped cucumber beetle.

The Garden Flea or Springtail.

Sminthurus hortensis Fitch.

Small seedling plants of many kinds are occasionally injured by very small jumping flea-like purplish insects which swarm in the soil and eat small holes in the leaves and stems, sometimes killing the plants. If the plants reach several inches in height and produce their second leaves, they will not be injured by these springtails.

The garden flea or springtail is about one-twentieth of an inch long, dark purple with pale yellow spots, and at the tip of the

abdomen there is borne a peculiar forked appendage by means of which it jumps.

This is one of the lowest forms of insects, and is very abundant for two or three weeks just as the seedlings are coming up.

Dusting with insect powder or ground tobacco is suggested as a remedy. Spraying with nicotine would doubtless kill great numbers of the springtails.

THE CUCUMBER OR POTATO FLEA-BEETLE.

Epitrix cucumeris Harris.

The seedling plants of cucumbers are often attacked and injured by a small black jumping beetle which eats holes in the leaves. This is the same pest that commonly injures potato, tomato, egg-plants and tobacco in Connecticut fields and is shown in figure 8. It is about one-sixteenth of an inch in length, legs and antennae are yellowish, wing-covers and thorax, jet black.

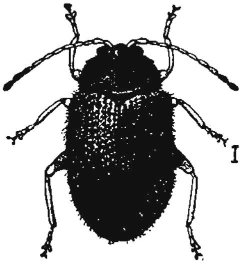

FIGURE 8. The cucumber flea beetle *Epitrix cucumeris,* greatly enlarged. (After Chittenden, Bureau of Entomology, U. S. Department of Agriculture.)

The adult beetles live through the winter under leaves and rubbish and the eggs are laid in May and June. The larvae are white thread-like worms which feed upon roots and therefore live and transform beneath the surface of the ground. Probably there are two, and possibly three, generations each year.

Flea beetles may be killed by arsenical sprays; driven away by repellents; or trapped by mechanical devices.

Ordinarily the application of lead arsenate to control the striped cucumber beetle will also control flea-beetles. Bordeaux mixture

is recognized as a repellent by gardeners, and may well be applied with the lead arsenate as it is needed to control certain fungous diseases and should be sprayed against both upper and under surfaces of the leaves.

Insect powder, one pound in ten gallons of water, or lead arsenate mixture in which gelatine has been incorporated gave the best results in tests in 1914 at the New Jersey Station.*

For controlling flea-beetles on potatoes, Prof. C. L. Metcalf devised a sticky box or trap which has been described,† but which is hardly necessary to consider in connection with cucurbitaceous plants. The application of lead arsenate will usually be found sufficiently effective.

The Squash-Vine Borer.

Melittia satyriniformis Hubn.

With the possible exception of the striped cucumber beetle, which is occasionally very destructive, the squash-vine borer is the most important pest of squashes and pumpkins in Connecticut. This insect causes the vines to wither in July and August, and to die before maturing their crop. Cucumbers and melons are seldom attacked if squashes and pumpkins are plentiful in the neighborhood.

The larva or borer tunnels in the main stem near the surface of the ground as shown on plate IV, and decay sets in often involving the whole stem which frequently becomes entirely severed, thus shutting off the supply of sap to the plant. The wilting is usually the first sign of attack, though an earlier examination would show the yellow pellets of frass or excrement which are thrown out of holes in the stem.

The adult is one of the clear-wing or Sesiid moths having a wing-spread of from one to one and one-fourth inches. The fore wings are opaque dark olive-green with a metallic luster and a fringe of brownish-black. The rear wings are transparent with a bluish reflection, and veins and fringe are black. The thorax and antennae are colored about like the fore wings, with

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* Report New Jersey Agricultural College Experiment Station for 1914, page 378.

† Journal of Economic Entomology, Vol. 8, page 240, 1915: Report Conn. Agr. Expt. Station for 1918, page 105.

abdomen reddish-brown, legs bright orange and tarsi black with white bands. When at rest the wings are folded horizontally as shown in figure 9, b.

The egg is about one millimeter in diameter, oval in outline, flattened at the point of attachment, and is dull red in color. The female may lay two hundred or more eggs, and at first these are deposited singly on the stem of the vine near its base during June or early July in Connecticut. Later in the season, the eggs may be laid at almost any point on the plant and the borers are often found in the leaf petioles. From six to fifteen days are

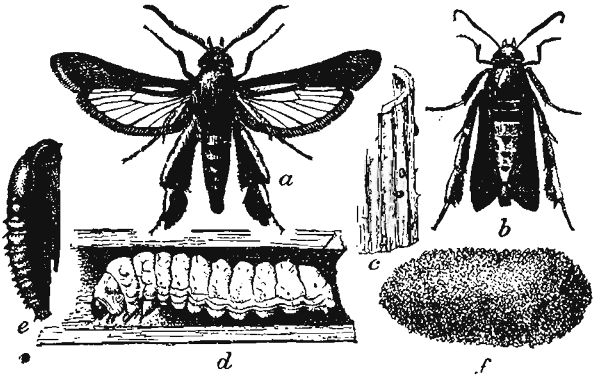


FIGURE 9. The squash borer: *a*, male moth; *b*, female, with wings folded as when at rest; *c*, eggs on section of squash stem; *d*, full-grown larva in the stem; *e*, pupa; *f*, pupal cell. All one-third larger than natural size. (After Chittenden, Circular 38, Bureau of Entomology, U. S. Department of Agriculture.)

required for the eggs to hatch and the young larvae enter the stem and begin their depredations, usually working toward the root, but frequently going in the opposite direction. Later in the summer the larvae may be found tunneling in all parts of the stem, leaf petioles and even in the fruit. The mature larva is a fat white grub, with black head, and is about an inch in length. When ready to transform it goes into the ground one or two inches below the surface, and spins a tough brownish cocoon, into the outer layer of which particles of soil are fastened. This cocoon is about three-fourths of an inch long. In Connecticut the caterpillars remain in their cocoons until the following season.

There are two broods in the South but only one in Connecticut. Between the latitudes of Long Island and Washington, D. C., there is a partial second brood.

The pupa is about five-eighths of an inch in length, is dark brown, and its head bears a sharp horn-like projection by means of which it cuts its way out of the cocoon.

This insect occurs throughout the eastern half of the United States from Canada south to Mexico and into South America.

METHODS OF CONTROL.

The application of arsenical and contact insecticides are of no avail against this insect. Cultural practices must be relied upon to hold it in check, and are as follows:—

(1) Plant early squashes as trap crops to be destroyed later.
(2) Cut out the borers with a knife.
(3) Cover the vines with soil to induce the growth of new roots.
(4) Collect and burn the old vines as soon as the crop is harvested.
(5) Crop rotation.

(1) In some localities growers have been successful in planting early varieties such as crooknecks between the rows or around the margins of the field. The moths will lay their eggs on these plants which can later be pulled up and burned. The main crop appearing later will escape the larger part of the infestation.

(2) Wherever a plant has become infested, a careful cut lengthwise the stem with a small, sharp knife will disclose the borer, which can then be killed with the knife. A careful examination of the basal portion of the vine will disclose the presence of a borer, as the yellow frass is always thrown out through a hole in the side of the stem. Such an examination should be made early in July and repeated several times during the month and even in August. If the vine has not been seriously injured and decay has not set in, the incision will heal.

(3) As there is always danger that a borer may be overlooked, each vine should be covered with soil at a point two or three feet from its base after it is well started running along the ground. New roots will be formed at this point and even if decay

wholly destroys the stem at its base the new roots enable the plant to keep on and mature its crop. The writer has seen a squash vine yield a good crop, when treated in this way, where the main stem was entirely severed from its root system.

(4) As the moths do not all appear at the same time, the egg-laying period extends over a long time or perhaps the greater portion of the summer. Consequently, larvae may be present somewhere in the vines late in the season. Gathering and burning the vines after the crop has been harvested will destroy many of these larvae which have not gone into the ground to pupate.

(5) As the squash-vine borer hibernates in the ground, it is advisable not to grow squashes on the same field year after year.

THE SQUASH LADY-BEETLE.

Epilachna borealis Fabr.

Though nearly all of the lady-beetles are carnivorous and therefore beneficial because they feed upon and destroy injurious insects such as aphids and scale insects, there is one exception in

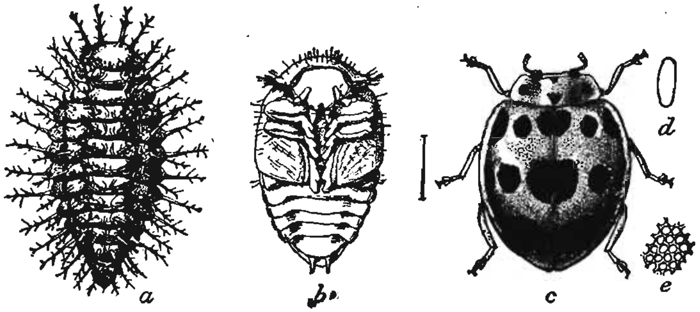
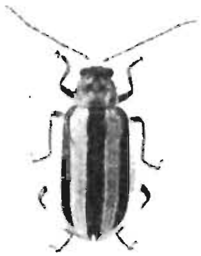


FIGURE 10. The squash lady-beetle: *a*, larva; *b*, pupa; *c*, adult beetle, three times natural size; *d*, egg, four times natural size; *e*, surface of same highly magnified. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

Connecticut in the squash lady-beetle. This species (both adults and larvae) feeds upon the leaves of cucurbitaceous plants but does more injury to squash than to the other plants of this group. The adult beetles pass the winter under the bark of dead trees,

PLATE I.

a. Eggs, as laid in the soil.
Five times enlarged.

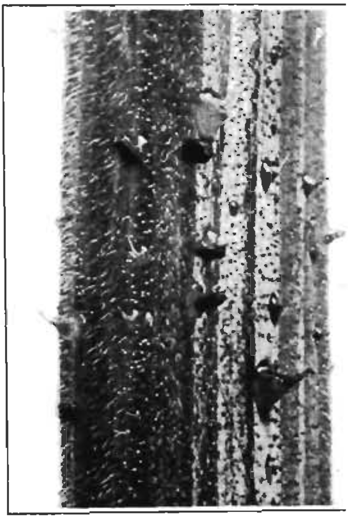


b. Striped cucumber beetle.
Enlarged four times.

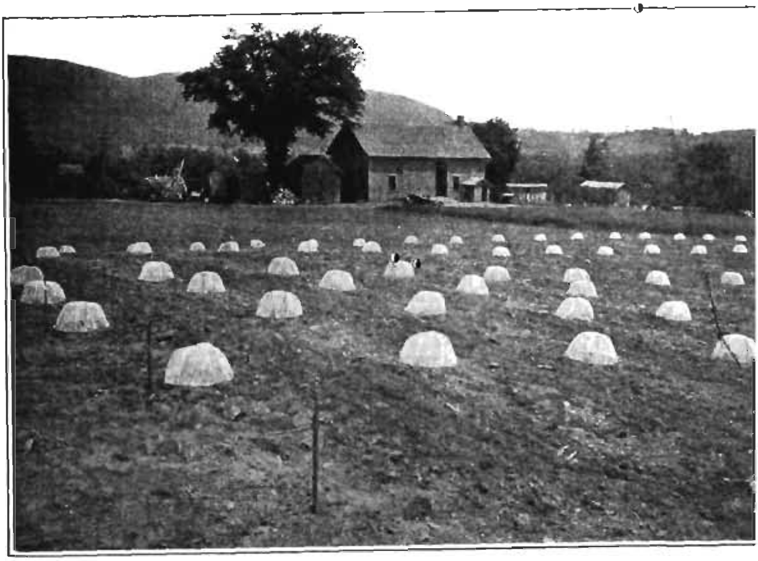
c. Work of the striped cucumber beetle. Natural size.

Cucumber plants injured by the larvae of the striped beetle.
Natural size.

a. Twelve-spotted cucumber beetle. Enlarged four times.

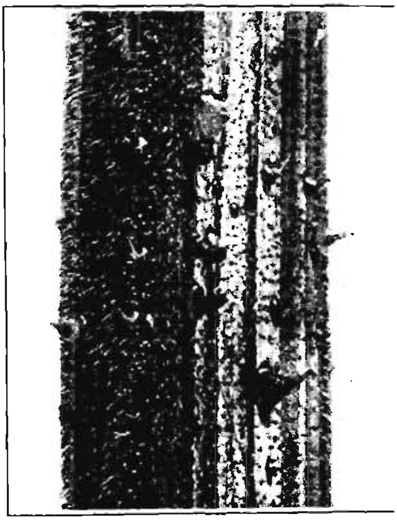


b. Eggs of squash-vine bore

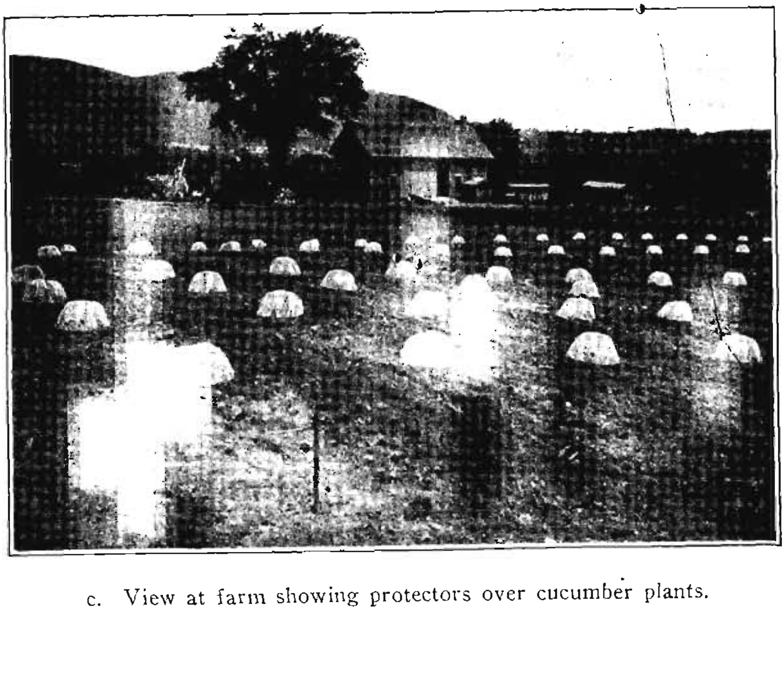


c. View at farm showing protectors over cucumber plants.

a. Twelve-spotted cucumber beetle. Enlarged four times.



b. Eggs of squash-vine borer.



c. View at farm showing protectors over cucumber plants.

ATE IV.

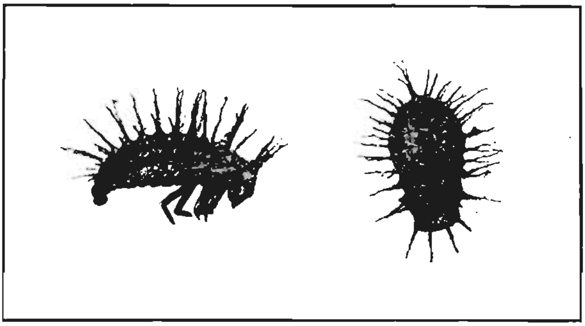
SQUASH BORER: ADULT AND WORK OF LARVAE IN SQUASH STEMS.

Slightly enlarged.

a. A field of healthy squash vines.

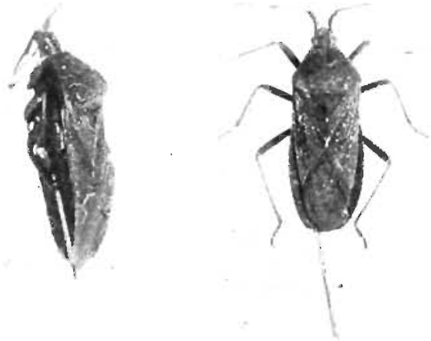
b. Vine wilting from the attacks of the squash-vine borer.

c. Squash lady-beetle. Twice natural size.

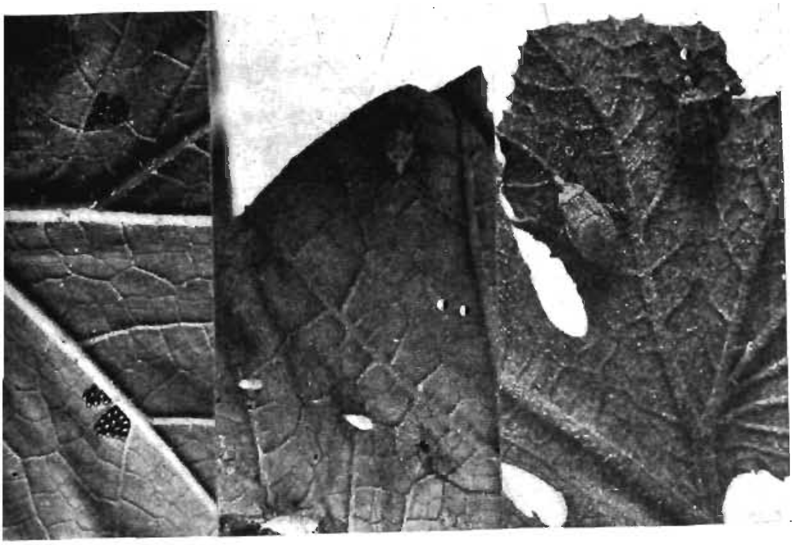


b. Larva of squash lady-beetle. Enlarged.

c. Work of the squash lady-beetle. Greatly reduced.

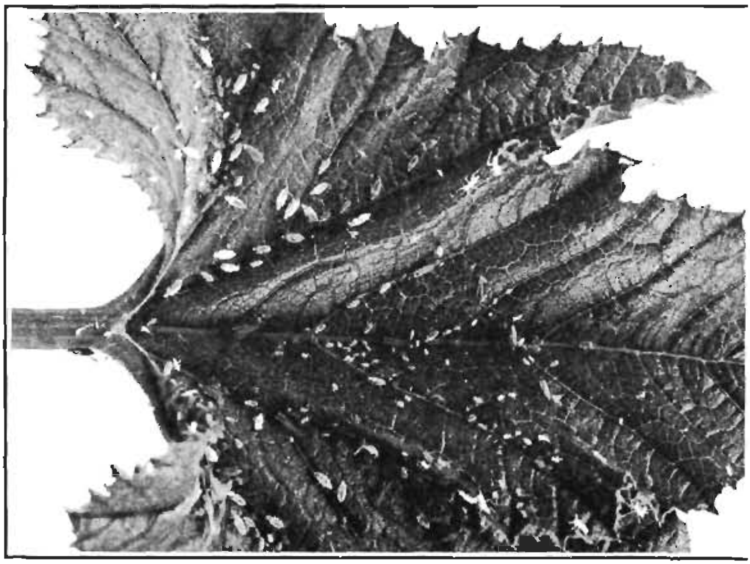


a. Squash bug. Twice natural size.



b. Eggs and young squash bugs. All natural size.

SQUASH BUG.



a. The potato aphid on squash leaf. Natural size.

b. Greenhouse white-fly. Adults and pupa skins. Enlarged four times.

:umps, etc., or other sheltered places, emerging in June and ,ying their eggs on the under surface of the squash leaves, 'hese hatch in about twelve days and the larvae begin to feed pon the under side of the leaves. The larvae appear in Connect- :ut about the middle of July and become fully grown in about ıree weeks or early in August. The larva is about three-eighths f an inch in length, yellow, with six rows of long black branched ›ines. The pupa is yellow and like those of its kind is attached / the tail to the under surface of the leaf: it lasts from six to ne days. There is only one generation each year. All stages : this insect are shown in figure 10; adults and larvae on plate I.

Though the larvae are found feeding upon the under side of leaf in July and August, the adults are generally present at the ıme time as well as earlier and later, feeding upon the upper ırface. The adult has the peculiar habit of marking out with ; mandibles a definite area on the leaf, and then feeding within is area. This form of injury is shown on plate VI, c. The ıuash lady-beetle is usually a minor pest being present only in nall numbers; handpicking is generally the best method of ›ntrol in such cases. If abundant the vines should be sprayed ith lead arsenate, using perhaps two pounds of the paste in :ty gallons of water.

Other Chewing Insects.

Cutworms.—The small plants are often eaten off by cutworms, hich are the larvae of several species of Noctuid moths. In nall plantations these can be hunted and crushed, but in large :lds where cutworms are destructive, the following mash should : employed:—

Wheat bran	5 pounds
Paris green or white arsenic	5 ounces
Lemon or orange	1 fruit
Molasses	1 pint
Water	7 pints

Mix the dry poison and bran together. Squeeze the juice from e orange or lemon into the water and also add the pulp and :el cut in small pieces: then add the molasses and stir. Mix e syrup thoroughly with the poisoned bran. This will make a ther dry mash which may be scattered thinly over the field

at the time when the injury is first noticed. As the cutworms feed at night, the mash should be applied just before dark: the cutworms will be attracted by the fresh citrus juice and molasses. If allowed to become dry before night, it will have lost in some measure its attraction for the cutworms. Late fall plowing and very thorough harrowing will reduce the numbers of cutworms.

Wireworms.—These are the larvae of click beetles and often are so abundant as to injure various crops. They are slender, hard, cylindrical grubs usually smooth and shiny and light brown in color. They injure plants by tunneling in the roots, especially the main stem below the surface of the ground. Crop rotation, fall plowing and thorough harrowing are the best preventives.

In the South, the pickle worm *Diaphania nitidalis* Stoll, and the melon worm *Diaphania hyalinata* Linn., cause much injury to crops of melons, cucumbers and squashes, but though they occur in Connecticut, they are rare and seldom are found feeding upon these plants in cultivated fields. Planting a succession of summer squashes at intervals of two weeks as trap crops seems to be the best method of controlling these insects.

Certain other general feeders sometimes attack squashes and cucumbers. The stalk borer *Papaipema nitela* Guen. was found by the writer in the stem of a melon plant in 1918. Various caterpillars of the families Noctuidae and Arctiidae occasionally feed upon the blossoms, leaves or young fruit, but can scarcely be considered as pests of the crop in Connecticut.

SUCKING INSECTS.

The Squash Bug.

Anasa tristis Degeer.

The squash bug, or "stink bug," is an important pest of squashes and pumpkins, though as a rule it does not injure cucumbers and melons in Connecticut. It injures the plants by puncturing the tissues of a vein on the under side of a leaf, and sucking out the sap. This causes the leaf to wilt badly and die. Frequently all the leaves on a vine wilt from the attacks of these bugs and the entire vine dies.

The range of this insect covers the entire United States, and is from Canada to Central America. The adult bugs hibernate

in any convenient place where they can find shelter, such as in old vines and rubbish, under loose bark, boards, etc., and emerge late in the spring and attack the young plants. In addition to their punctures and withdrawal of sap from the plant, it is

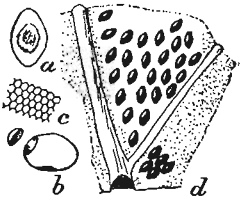


FIGURE 11. Eggs of squash bug as they are laid on the under side of a leaf. Enlarged. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

thought that some poisonous substance is injected into the wound. A few punctures are sufficient to kill a small plant.

The female bugs lay on the under side of the leaves, dark brown shiny eggs in clusters containing between twenty and forty each, arranged in more or less regular rows, often in the

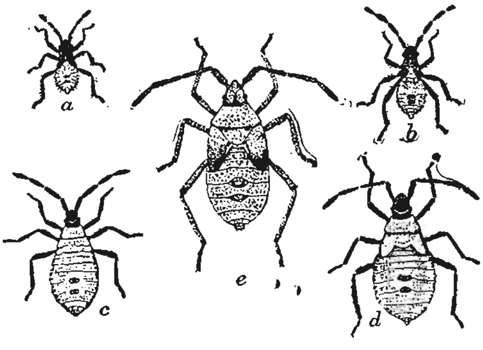


FIGURE 12. Nymphs of the squash bug; different stages, about twice natural size. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

forks of veins, as shown in figure 11. From six to fifteen days afterward, these eggs hatch and the young nymphs remain together on the under side of the leaf where the egg cluster was laid. They are at first green with pink head, legs and antennae,

but after the first molt, they are ash-gray in color. They molt five times during the nymphal period of four or five weeks, during which they are sucking the sap from the plants. The nymphs are shown in figure 12, and on plate VII, b.

The full-grown bug is about five-eighths of an inch long, dark grayish-brown in color, and when not feeding or laying eggs, the adults and larger nymphs gather round the base of the plant or under clods of earth. Frequently they congregate on the immature fruits, especially where the foliage has been killed by frost before the nymphs reach maturity. There is only one

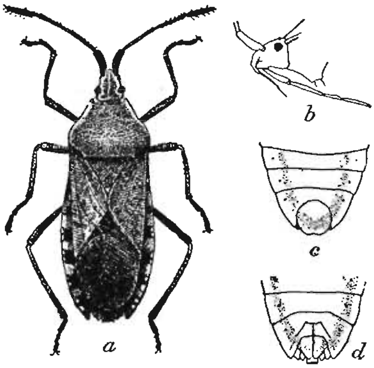


FIGURE 13. The squash bug: *a*, mature female, twice natural size; *b*, side view of head showing proboscis; *c*, abdominal segments of male; *d*, same of female. Enlarged. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

generation each year. Adults are shown in figure 13, and on plate VII, a, and the beak or sucking mouth in figure 14.

In the South there are two other species of this genus which are associated with the squash bug and cause similar injury to the plants though less abundant. In the southern states, the southern leaf-footed plant bug *Leptoglossus phyllopus* Linn. injures melons and various other vegetable crops, and in the central states, the northern leaf-footed plant bug *Leptoglossus oppositus* Say, occasionally attacks cucurbitaceous plants, but these insects have not been recorded from Connecticut.

Methods of Control.—The adults are hard to kill and such methods as the burning of all old vines and rubbish around the

field, trapping under boards and handpicking are the means of destroying them. Egg-masses on the leaves may be crushed, or scraped off with the edge of a knife. The nymphs, especially the younger ones, may be killed by spraying with kerosene emulsion,

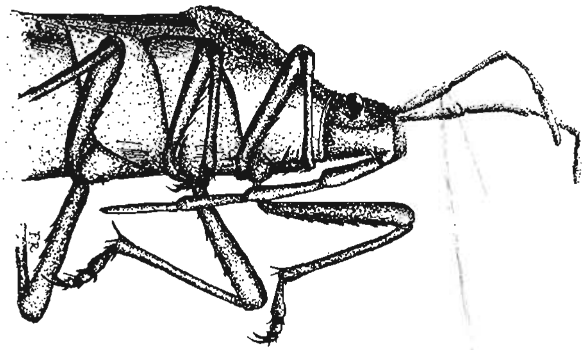


FIGURE 14. Squash bug. Enlarged view showing head and proboscis.

or with nicotine solution, two teaspoonfuls in a gallon of water, to which an inch cube of laundry soap has been dissolved and added. In applying any spray to kill the nymphs, it is necessary to use an upturned nozzle in order to direct the spray against them on the under side of the leaves.

THE MELON APHID.

Aphis gossypii Glover.

This is one of the most troublesome insect pests of cucumbers and melons throughout its range over the eastern half of the United States and southward into Brazil. In Connecticut it is present in nearly every field of cucumbers and melons, and being on the under side of the leaves, it escapes notice until the leaves begin to curl on account of its attacks. It is much less troublesome on squashes and pumpkins, but has a long list of food plants, including many of our common vegetables, and cotton in the South. It is apparently able to subsist on a large number of common weeds, though its complete life history is still unknown. Whether it produces winter eggs, or each year migrates from the South, or lives over in greenhouses is still a matter for specula-

tion. It is able to multiply so rapidly that plants are often injured in a short time. The infested leaves curl backward or downward, making it very difficult to reach the aphids with a spray. The melon aphid is shown in figure 15. It is preyed upon by our common lady-beetles, larvae of syrphid flies, lace-

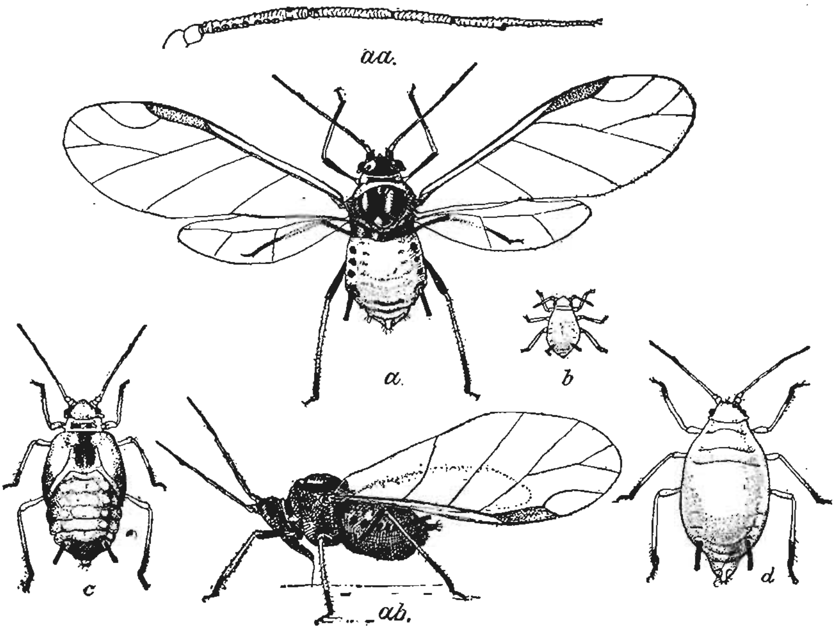


FIGURE 15. The melon aphis: *a*, winged female; *aa*, enlarged antenna of same; *ab*, dark form, side view; *b*, young nymph; *c*, last stage of nymph; *d*, wingless female. All greatly enlarged. (After Chittenden, Circular 80, Bureau of Entomology, U. S. Department of Agriculture.)

wing flies, and several species of parasitic four-winged flies aid in holding it in check.

Control.—In small gardens the vines can be watched and when the aphids first appear, the vines should be sprayed or fumigated to kill them. For fumigating, covers can be made by stretching table oilcloth over light wood frames. Each frame should be large enough to cover a hill, and either carbon disulphide (bisulphide) one teaspoonful to each cubic foot of space, or tobacco fumes may be employed as a fumigant. The former should be

placed in a shallow dish or saucer under the cover. Tobacco fumes may be obtained by burning tobacco stems, or some preparation of nicotine and paper.

In spraying, either kerosene emulsion or nicotine solution may be used, and the nozzle should be upturned by using a rod bent near the nozzle. The spraying operation will be facilitated by training all vines to run along the rows instead of across them.

If nicotine solution is used, it should be in the proportions of one-half pint of "Black Leaf 40" in fifty gallons of water, to which about three pounds of laundry soap has been dissolved and added.

Kerosene emulsion may be prepared as follows

Laundry soap (about 30 oz.)	3 cakes
Kerosene	3 gallons
Water	2 gallons

After churning, dilute eight times to make one barrel (50 gallons.)

The soap should be cut into thin slices and dissolved in hot water over a fire. Then remove from the fire, add the kerosene and churn vigorously for a few moments by passing the liquid through a spray pump having a small opening in the nozzle, and the stream directed back into the container. This makes a uniform creamy mass from which the oil does not separate on standing. Then dilute with the necessary amount of water and spray against the under surface of the leaves.

In all spraying operations a good pressure should be maintained, and a fine nozzle used. In commercial plantations, sometimes the first plants found to be infested are pulled up and buried or burned to kill the aphids. Dusting with insect powder or fine tobacco dust applied with a powder gun is also practiced in some cases. In any event, the treatment should be given before the leaves have curled as it is difficult afterward to hit the aphids.

The Squash Aphid.

Macrosiphum cucurbitae Middleton.

This is a light green aphid, considerably larger than the melon aphid, but is never as abundant and therefore never as destructive as that species.

The Potato Aphid, *Macrosiphum solanifolii* Ashm., was found on squash at the Station in 1909 and again in 1914. It is shown on plate VIII, a.

Both the aphids mentioned above, if sufficiently abundant to warrant the outlay, may be controlled by the same methods advised for the melon aphid.

The Greenhouse White-Fly.

Asterochiton (Aleyrodes) vaporariorum Westwood.

Cucurbits growing under glass or out of doors near greenhouses are often attacked and considerably injured by the greenhouse white-fly. The white moth-like adults are found resting on the under sides of the leaves where they lay eggs and where the nymphs also occur. The eggs are very small, ovate, whitish, and are attached to the leaf by a short stalk at the larger end. The nymphs are oval, flat, light green, and resemble scale-insects. The empty pupa skins are silvery white and adhere for a long time to the leaf. The adults are pure white and in appearance look as if sprinkled with flour. This insect is shown on plate VIII, b, but a more detailed description may be found in the Reports of this Station for 1902, page 148, and for 1906, page 275.

The same treatment recommended for the melon aphid will control the greenhouse white-fly. Spraying with soap and water (common laundry soap, one pound dissolved in eight gallons) is also effective.

In greenhouses it is often advisable to fumigate the entire house with hydrocyanic acid gas, using one-half ounce of cyanide for each thousand cubic feet of space with an exposure of three hours. This is by far the most effective of all treatments. If spraying is depended upon to hold the pest in check it must be repeated frequently.

Summary.

Chewing insects which attack and injure squash, pumpkin, cucumber and melon plants in Connecticut are the striped cucumber beetle, the squash-vine borer, and occasionally the twelve-spotted cucumber beetle, the cucumber flea beetle, the garden flea or springtail, the squash lady-beetle, cutworms and wire-

worms. The striped and twelve-spotted beetles can be controlled by covering the plants with netting, or by spraying or dusting them with lead arsenate. The cucumber flea-beetle and the squash lady-beetle may likewise be controlled with lead arsenate.

To control the squash-vine borer, plant early squashes as a trap crop to be destroyed later: cut out the borers with a knife: cover the stems of the vines with soil to induce the formation of new roots: collect and burn all the old vines as soon as the crop is harvested. Cutworms can best be controlled by the use of a poisoned bran mash, and wireworms by fall plowing and rotation of crops.

The most troublesome sucking insects on cucurbits in Connecticut are the squash bug and the melon aphid. Minor pests of this nature are the squash aphid, potato aphid, and greenhouse white-fly. All of these pests can be controlled by spraying at the right time with nicotine solution and soap, with kerosene emulsion, or by fumigating.

Gathering and burning the old vines and other rubbish on the field after the crop has been harvested is a worthy practice and will tend to reduce the numbers of all insects attacking the crop.

Rotation of crops should also be practiced, where possible.

Information concerning each of these pests and how to control them is given in the foregoing pages, and most of them are shown on plates I-VIII.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN 217 **DECEMBER, 1919**

Fertilizer Report for 1919

By E. H. JENKINS, *Director, and*
E. MONROE BAILEY, *Chemist in Charge of the Analytical Laboratory.*

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Report on Commercial Fertilizers, 1919.

By E. H. Jenkins, *Director, and* E. M. Bailey,
Chemist in Charge of the Analytical Laboratory.

In 1919, forty-eight individuals and firms entered 339 brands of fertilizers for sale in this state, classified as follows:

Nitrogenous superphosphates with potash	108
Nitrogenous superphosphates without potash	158
Bone manures and tankage	23
Fish, castor pomace, chemicals and miscellaneous	50
Total	339

During the spring months Mr. Churchill, the Station's agent, visited 98 towns and villages in the state and gathered 501 samples. These represented all the registered brands except the following:

American Agricultural Chemical Co.'s Grass and Oats Fertilizer[1], East India Mayflower 1916[1]; *Bowker's* Stockbridge 5-8 General Crop; *Listers'* Complete Tobacco Manure 1916[1], Crescent Ammoniated Superphosphate 1916[1], Excelsior Guano 1916, 1-8-2 Fertilizer[1], Squirrel Brand Fertilizer 1916[1]; *National* Nitrogen Phosphate Mixture No. 6; *Nitrate Agencies Co.'s* Ground Bone, 4-8-2 Fish and Potash Formula, H. G. Ground Tankage; *Parmenter & Polsey's* Potato Fertilizer; *Pawtucket Rendering Co.'s* Animal 3½-10[2]; *Sanderson's* Plain Superphosphate.[3]

[1] Not sold in the state.
[2] Manufacturer's sample analyzed.
[3] Purchaser's sample analyzed.

Of the fifteen samples above listed six were not sold in the state, and of two other brands, one manufacturer's sample and one purchaser's sample were analyzed.

CLASSIFICATION OF FERTILIZERS ANALYZED.

	Number of samples.
1. *Containing nitrogen as the chief active ingredient:*	
Nitrate of soda	8
Sulphate of ammonia	1
Cotton seed meal	95
Castor pomace	4
Peanut meal	1
2. *Containing phosphoric acid as the chief active ingredient:*	
"Barium-phosphate"	3
Raw rock phosphate	2
Precipitated bone phosphate	2
Basic lime phosphate	2
Acid phosphate	16
3. *Containing potash as the chief active ingredient:*	
Cotton hull ashes	3
Other potash materials	13
4. *Containing nitrogen and phosphoric acid:*	
Fish manures	15
Slaughter house tankage	9
Bone and tankage	1
Bone manures	16
5. *Mixed fertilizers:*	
Nitrogenous superphosphates without potash	166
Nitrogenous superphosphates with potash	108
Home-mixed fertilizers	4
6. *Miscellaneous fertilizers and waste products:*	
Tobacco stems and stalks	3
Lime-Fertile and Nitro-Fertile	2
Sheep manure	10
Wood ashes	21
Lime and lime-kiln ashes	3
Peat and muck	7
Other miscellaneous articles (soils not included)	27
Total	542

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA.

Eight samples were analyzed as follows:

12533. Sold by Apothecaries Hall Co., Waterbury. Sampled at the factory.

12562. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled at the factory.

12889. Sold by Coe-Mortimer Co., New York City. Stock of C. E. Taylor, Meriden.

12734. Sold by Armour Fertilizer Works, Chrome, N. J. Stock of Geo. S. Phelps & Co., Thompsonville.

12728. Sold by American Agricultural Chemical Co., New York City. Stock of C. Buckingham, Southport.

12987. Sold by Nitrate Agencies Co., New York City. Stock of F. S. Platt Co., New Haven.

12718. Sent by G. S. Jennings, Southport.

12891. Sold by Wilcox Fertilizer Co., Mystic. Sampled at factory.

ANALYSES OF NITRATE OF SODA.

Station No.	12533	12562	12889	12734	12728	12987	12718	12891
Per cent. of								
Nitrogen guaranteed	15.00	15.00	15.00	14.81	15.00	15.00	....	15.00
Nitrogen found	15.60	15.08	15.04	15.64	15.42	15.80	15.92	15.36
Cost per ton	$90.00	90.00	95.00	100.00	100.00	110.00	....	....
Nitrogen costs cents per pound	28.8	29.8	31.5*	31.9	32.4	34.8	....	....

All of the samples examined fully met their guaranties and all were of average quality.

The cost of nitrogen in these samples ranged from about 29 to 35 cents per pound, the average being 31.5 cents.

Nitrate of soda has been a relatively cheap source of fertilizer nitrogen this year. The nitrogen in it is more quickly and completely available to crops than nitrogen from any other commercial source. As a spring top-dressing on grass land and on

* [illegible]

winter grain which has suffered some winter-killing, as well as a source of nitrogen in home mixtures, nitrate of soda deserves more attention and use than it has received from farmers.

The figures gathered by the Bureau of Soils at Washington indicate that about 29 per cent. of the nitrogen in the mixed fertilizers made in 1918 was in form of nitrate of soda, 16 per cent. in form of sulphate of ammonia and the balance, about 55 per cent., in organic forms. These percentages probably will change with changes in the relative cost of the three forms of nitrogen.

The price of nitrate in Chili is fixed by what is bid in the London market. During the war the demands for the manufacture of munitions and the scarcity of shipping, high insurance rates, etc., caused nitrate to advance sharply in price and then to disappear from the market. At this writing, November, 1919, the wholesale quotation is $58 per ton which should represent a retail price of about $70.

SULPHATE OF AMMONIA.

Only a single sample was examined.

12560. Sold by the Barrett Co., New York City. Stock of Berkshire Fertilizer Co. Cost $100 per ton. It contained 20.9 per cent. of nitrogen. Nitrogen in this article therefore cost 23.9 cents per pound, which is the cheapest source of nitrogen that has been in our market this year.

COTTON SEED MEAL.

Ninety-five samples of meal bought for use as a fertilizer have been examined.

Seventy-six of them met their guaranteed compositions and need no further notice here. Seventeen failed to meet their guaranties and their analyses appear in the following table.

The average percentage of nitrogen in the 95 samples examined was 5.97 and the average ton cost, in car lots, $63.21.

The average nitrogen content of the samples which met their guaranty was 6.11 per cent.; the average of those which failed to meet their guaranties was 5.71 per cent.

Cotton seed meal contains about 2.9 per cent. of phosphoric acid and 1.9 per cent. of potash.

These ingredients are not guaranteed and are disregarded in sales. Charging the cost of meal wholly to nitrogen, the average cost per pound of nitrogen has been 53 cents.

If the phosphoric acid in the meal is credited at 6 cents and potash at 30 cents, the average cost of nitrogen as shown by our analyses has been 40.5 cents per pound.

The average figures for the past seven years are as follows:

Year.	Number analyzed.	Cost per ton.	Per cent. nitrogen.	Nitrogen costs cents per pound.
1913	315	$33.00	6.89	20.7
1914	224	....	6.77	21.6
1915	182	....	6.96	19.9
1916	177	39.52	6.65	20.9
1917	95	44.20	6.10	26.5
1918	56	57.41	5.98	36.0
1919	95	63.21	5.97	40.5

There has been a yearly rise in the average price of cotton seed meal, amounting to 91 per cent., a yearly decrease in the amount of nitrogen amounting to 13 per cent. and in consequence the actual cost per pound of nitrogen has increased nearly 95 per cent. At this writing, November 1919, cotton seed meal is quoted in New York at $70 to $75 per ton.

As evidence of the economic confusion wrought by the war, it is stated that Egypt has 85,000 tons of meal for which there is no home demand and no shipping available to transport it.

Coal on the other hand is hard to get at $80 per ton in that country and cotton seed cake is being used for heating. 1¾ tons of cake is said to be the equivalent in heating power of one ton of coal.

There appears to be no present prospect of cheaper cotton seed meal in the market.

Under the new fertilizer law cotton seed meal is classed as a commercial fertilizer and is subject to the same requirements as any other fertilizer.

CASTOR POMACE.

Four samples were analyzed as follows:

12730. Sold by American Agricultural Chemical Co., New York City. Stock of W. Howard, Windsor.

12732. Sold by Apothecaries Hall Co., Waterbury. Stock of Wm. J. Reeves, Windsorville.

Cotton Seed Meals Below Guaranty.

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.	Cost per ton.
	American Cotton Oil Co., New York City.				
12449	62640	Griffin Tobacco Co., No. Bloomfield	4.14	5.76	....
	F. W. Brode & Co., Memphis, Tenn.				
12028	34825	Ernest N. Austin, Suffield	6.32	6.58	$56.00
12737	....	E. N. Austin, Suffield	6.29	6.50	60.00
	The Buckeye Cotton Oil Co., Cincinnati, Ohio.				
12454	40069	Griffin Tobacco Co., No. Bloomfield	5.50	5.76	....
12457	88578	Griffin Tobacco Co., No. Bloomfield	5.47	5.76	....
12624	2240 N. Y., P. & N.	Spencer Bros., Inc., Suffield	5.48	5.76	65.00
12625	52310 P. M.	Spencer Bros., Inc., Suffield	5.53	5.76	65.00
12679	2775 L. & N.	Spencer Bros., Inc., Suffield	5.20	5.76	65.00
12741	97818 Erie	Spencer Bros., Inc., Suffield	5.48	5.76	64.50
	E. Crosby & Co., Brattleboro, Vt.				
12659	52618 G. K.	George S. Phelps & Co., Thompsonville	5.51	5.75	66.00
	Humphreys-Godwin Co., Memphis, Tenn.				
12796	142132 I. C.	Loomis Bros Co., Granby	4.89	5.76	....
	Olds & Whipple, Hartford.				
11512	....	O. H. Osborne, Warehouse Point	6.34	7.00	....
12194	....	....	6.68	7.00	....
	Park & Pollard Co., Boston, Mass.				
12771	....	Ahern Bros., East Windsor Hill	6.30	6.56	....
12687	71464 U. P.	Ahern Bros., East Windsor Hill	6.28	6.56	72.00
	J. E. Soper Co., Boston, Mass.				
12501	43588 R. I.	Spencer Bros., Inc., Suffield	5.33	5.76	64.50
12502	115177 N. Y. C. & H. R.	Spencer Bros., Inc., Suffield	5.57	5.76	64.50

12565. Sold by H. J. Baker & Bro., New York City. Stock of Olds & Whipple, Hartford.

12665. Sent by L. J. Prior, East Hartford.

ANALYSES OF CASTOR POMACE.

Station No.	12730	12732	12565	12665
Per cent. of				
Nitrogen guaranteed	4.53	4.52	4.50	....
Nitrogen found	4.43	5.34	5.82	5.45
Cost per ton	$62.00	$55.00	$55.10	....

Castor pomace of average composition contains about 1.95 per cent. of phosphoric acid and 0.95 per cent. of potash. If we value them at 6 cents and 30 cents per pound respectively

Castor pomace at about the average price of $57 per ton has furnished nitrogen for about 47.1 cents per pound, six cents more than its cost in cotton seed meal.

PEANUT MEAL.

11719. Peanut meal, sent by F. B. Sherwood, New Milford, contains nitrogen 6.30 per cent., phosphoric acid 1.51 and potash 1.42 per cent. There can be little doubt that it would serve as a substitute for cotton seed meal in tobacco fertilizers.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

BARIUM-PHOSPHATE.

12567. Grade B. Sold by Witherbee, Sherman & Co., Port Henry, N. Y. Stock of A. N. Pierson Inc., Cromwell. Guaranteed 16 per cent. phosphoric acid. Cost $18.00 per ton.

It contained 15.61 per cent. phosphoric acid, chiefly in insoluble form.

12892. Grade C. Sold by Witherbee, Sherman & Co., Port Henry, N. Y. Stock of Raymond Coleman, Cheshire. Guaranteed 14 per cent. phosphoric acid. Cost $22.50 per ton.

It contained 14.98 per cent. phosphoric acid. Barium-Phosphate is a misnomer. The material is apparently a mixture of ground apatite with some sulphide of barium.

The state of combination of the sulphur in this mixture is shown in the following table.

12567 is new stock. **12306** is material which had lain in storage since last year.

	12567	12306
Total phosphoric acid	15.61	15.35
"Available" phosphoric acid	0.54	0.52
Insoluble phosphoric acid	15.07	14.83

	12567	12306
Total sulphur	0.88	1.49
Of which as sulphide	0.63	0.58
Of which as sulphate	0.03	0.28
Of which as thiosulphate	0.22	0.63
Total barium	3.12	5.42
Of which soluble in acid	3.01	4.28
Free sulphur	....	.0025

The differences between the two are probably in part due to atmospheric action and in part are differences in the original composition.

The actual amount of barium sulphide cannot exceed 3.32 per cent.

RAW ROCK PHOSPHATE.

Two samples were analyzed as follows:

13321. Tacco Ground Phosphate. Sold by Tennessee Agricultural Chemical Corporation, Centerville, Tenn. Sent by A. W. Forbes, East Haven.

12890. Phoslime. Sold by Florida Soft Phosphate & Lime Co., Ocala, Fla. Stock of Meriden Grain & Feed Co., Meriden.

Analyses of Raw Rock Phosphate.

Station No.	13321	12890
Water-soluble phosphoric acid	0.16	....
Citrate-soluble phosphoric acid	1.19	....
Citrate-insoluble phosphoric acid	25.74	....
Total phosphoric acid	27.09	21.95
"Available" phosphoric acid found	1.35	....
Cost per ton	....	$40.00

PRECIPITATED BONE PHOSPHATE.

Two samples analyzed as follows:

12726. Sold by Olds & Whipple, Hartford. Sampled at factory. Cost $1.60 per unit available phosphoric acid.

12667. Sent by L. J. Prior, East Hartford.

Analyses of Precipitated Bone Phosphate.

Station No.	12726	12667
Water-soluble phosphoric acid	2.12	1.86
Citrate-soluble phosphoric acid	26.80	32.48
Citrate-insoluble phosphoric acid	3.44	3.58
Total phosphoric acid	32.36	37.92
"Available" phosphoric acid found	28.92	34.34
"Available" phosphoric acid guaranteed	32.00	....
Cost of "available" phosphoric acid per pound	**8¢**	....

This is essentially a calcium phosphate, a by-product of chemical manufacture, very fine and, as the analyses show, in very soluble condition.

BASIC LIME PHOSPHATE.

Two samples were analyzed as follows:

12729. Sold by American Agricultural Chemical Co., New York City. Stock of S. B. Warner, Windsor. Cost $27.75 per ton. Guaranteed 13 per cent. "available" phosphoric acid, 14 per cent. total phosphoric acid.

12800. Basic Fruit and Legume Phosphate. Sold by Coe Mortimer Co., New York City. Stock of J. M. Harmon, Meriden. Cost $24.50 per ton. Guaranteed 13 per cent. "available" phosphoric acid, 14 per cent. total phosphoric acid.

Analyses of Basic Lime Phosphate.

Station No.	12729	12800
Water-soluble phosphoric acid	1.40	6.62
Citrate-soluble phosphoric acid	12.74	7.42
Citrate-insoluble phosphoric acid	1.13	1.06
Total phosphoric acid	15.27	15.10
"Available" phosphoric acid	14.14	14.04
Cost of "available" phosphoric acid per pound	**9.8¢**	**8.7¢**

DISSOLVED ROCK PHOSPHATE OR ACID PHOSPHATE.

Sixteen samples were analyzed as follows:

12669. Sold by Baugh Chemical Co., Baltimore, Md. Stock of Farmers' Exchange, Meriden.

12951. Sold by Wilcox Fertilizer Co., Mystic. Stock of M. E. Thompson, Ellington.

12723. Sold by L. T. Frisbie Co., New Haven. Stock of F. S. Platt Co., New Haven.

12561. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled at factory.

12802. Sold by Coe-Mortimer Co., New York City. Stock of Conyers Farm, Greenwich.

12969. Sold by National Fertilizer Co., New York City. Stock of W. L. Thorpe, North Haven.

12558. Sold by Apothecaries Hall Co., Waterbury. Sampled at factory.

12736. Sold by Bowker Fertilizer Co., New York City. Stock of C. G. Lawton, Brooklyn, Conn.

12563. Sold by F. S. Royster Guano Co., Baltimore, Md. Stock of F. E. Beach, Branford.

12557. Sold by American Agricultural Chemical Co., New York City. Stock of D. L. Clark & Son, Milford.

12733. Sold by Armour Fertilizer Works, Chrome, N. J. Stock of Quality Seed Store, Stamford.

12712. Sold by Coe-Mortimer Co., New York City. Stock of Gunther Bros., Rockville.

12559. Sold by American Agricultural Chemical Co., New York City. Stock of W. J. Lobdell, Stratford.

12609. Sold by American Agricultural Chemical Co., New York City. Stock of E. H. Latimer & Son, Southington.

12810. Sold by Nitrate Agencies Co., New York City. Stock of A. F. Brinckeroff, Georgetown, Conn.

12689. Sold by Sanderson Fertilizer and Chemical Co., New Haven. Sent by J. L. Watrous, Middlefield.

ANALYSES OF ACID PHOSPHATE.

Station No.	Water-soluble phosphoric acid.	Citrate-soluble phosphoric acid.	Citrate-insoluble phosphoric acid.	Total phosphoric acid.	"Available" phosphoric acid found.	"Available" phosphoric acid guaranteed.	Cost per ton.	"Available" phosphoric acid cost cents per pound.
12669	12.79	2.74	1.39	16.92	15.53	16.00	$24.75	7.9
12951	15.48	2.39	0.14	18.01	17.87	16.00	31.00	8.6
12723	14.82	3.04	0.13	17.99	17.86	16.00	32.00	8.9
12561	13.53	3.17	0.38	17.08	16.70	16.00	30.00	8.9
12802	12.48	3.62	1.55	17.65	16.10	16.00	31.50	9.7
12969	14.14	2.30	1.65	18.09	16.44	16.00	34.00	10.3
12558	10.68	3.37	0.14	14.19	14.05	14.00	30.00	10.6
12736	11.88	2.88	1.42	16.18	14.76	14.00	32.00	10.7
12563	10.63	4.70	1.34	16.67	15.33	16.00	33.00	10.7
12557	11.18	2.97	1.48	15.63	14.15	14.00	30.69	10.8
12733	13.99	2.84	0.06	16.89	16.83	16.00	40.00	11.8
12712	11.85	4.76	1.36	17.97	16.61	14.00	31.50	13.5
12559	12.31	3.22	1.92	17.45	15.53	16.00	30.00	14.2
12609	13.45	2.72	1.43	17.60	16.17	16.00	....	....
12810	13.57	2.54	2.02	18.13	16.11	16.00	....	....
12689	14.14	3.52	0.43	18.09	17.66	16.00	....	....

The cost of available phosphoric acid in this form has ranged from 7.9 to 14.2 cents per pound, an average of 10.5 cents. It has cost about one cent a pound more in the 14 per cent. goods than in the 16 per cent.

The average prices given in our reports for the last 8 years are as follows:

1912	5.6 cents
1913	4.7
1914	4.65
1915	3.99
1916	6.7
1917	6.2
1918	7.9
1919	10.5

The price of acid phosphate has advanced almost to prohibitive prices in spite of the fact that oil of vitriol, which combined with lime makes up about half the weight of acid phosphate, has declined in price since the armistice. Various contributing causes have been brought forward to explain the facts: The increased cost of labor and of freight, the scarcity of shipping to bring the rock to northern factories, a strike at the phosphate mines which has for a time stopped the output of rock phosphate, car shortage and the indisposition of manufacturers to sell farmers anything other than ready mixed fertilizers at a reasonable price. The practice of selling acid phosphate on condition that a certain amount of mixed fertilizer is sold with it is an unfair and illegal practice under the laws at present in force.

The effect of this situation is, in our judgment, to increase the sales of raw phosphates, ground apatite mixed with barium sulphide, Tennessee floats and fine ground soft Florida rock, rather than to increase the use of factory mixed goods, and to the trial of all possible home mixtures to increase the availability of these slower acting forms of phosphoric acid.

From the preceding discussion we may put together the approximate cost per pound of phosphoric acid in those articles in which phosphoric acid is the chief fertilizing ingredient.

Total phosphoric acid	
In barium-phosphate	5.7–7.5
Florida soft phosphate	9.1
Available phosphoric acid	
Acid phosphate	10.5
Basic lime phosphate	8.7–9.8
Precipitated bone phosphate	8.0

At these prices certainly precipitated bone phosphate has been the best purchase, price and fertilizing value considered.

Considering the relative cost of "available" phosphoric acid and the two forms of less soluble phosphoric acid, it is quite certain that on our light humus-poor soils and for the variety of crops generally grown in the state the more soluble forms at present prices are preferable.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

COTTON HULL ASHES.

Three samples were analyzed as follows:

12480. Sold by Olds & Whipple, Hartford. Stock of John Wolf, Windsor. Cost $6 per unit of water-soluble potash, equivalent to 30 cents per pound for actual potash. It contained 29.30 per cent. potash.

12654. Sold by Olds & Whipple, Hartford. Stock of John Wolf, Windsor. Cost $6 per unit of water-soluble potash, equivalent to 30 cents per pound for actual potash. It contained 19.10 per cent. of potash.

12902. Sold by Olds & Whipple, Hartford. Stock of New England Tobacco Corp., John Wolf, manager, Windsor. Cost $4 per unit of water-soluble potash, equivalent to 20 cents per pound for actual potash. It contained 25.70 per cent. of potash.

Sample **12480** was sold in March. The price of **12902**, sold by the same firm three months later, reflects the falling price of potash.

POTASH SALTS.

The following analyses show the composition of potash salts from various sources, probably all of them American. They were not taken from stock on sale in this state, but were contributed chiefly by Prof. Whitney, chief of the U. S. Bureau of Soils:

		Per cent. of water-soluble potash.
12438	Muriate of potash from kelp	60.08
12440	Kelp ash	36.72
12439	Searles Lake ("Trona Potash")	31.98
12442	Nebraska potash	26.20
12441	Potash extracted from green sand marl	53.80
12443	Potash from blast furnace	12.28[1]
12444	Cement flue blast furnace	11.30[2]
12445	Molasses residue	38.06[3]

[1] Total potash 20.46.
[2] Total potash 12.76.
[3] 20.14 per cent. as muriate, 12.42 as sulphate, 5.51 as carbonate.

The Searles Lake potash contains borax in considerable amount. A very large amount of borax in a fertilizer may cause injury or ruin to crops. The U. S. Department of Agriculture, acting under authority conferred during the war, has ordered manufacturers not to sell fertilizers containing more than 0.1 per cent. borax without plainly showing the amount of borax on the containers.

The following samples were taken in the Connecticut market:

12485. American Potash. Sent by Prof. W. L. Slate, Jr., Storrs, Conn. It contained 52.36 per cent. of potash.

12509. Antioch Nebraska Potash. It contained 22.18 per cent. of which 4.41 per cent. was muriate and 17.77 per cent. sulphate.

OTHER MATERIALS CONTAINING POTASH.

12029. Alpha Potash-Lime Fertilizer. Made by Alpha Portland Cement Co., Easton, Pa. Sent by E. N. Austin, Suffield. It contained 2.33 per cent. of potash and 25.92 per cent. of lime. Cost $13 per ton.

12568. Alpha Potash-Lime Fertilizer. Made by Alpha Portland Cement Co., Easton, Pa. Stock of Louis H. Porter, Stamford. Guaranteed 2.50 per cent. potash. It contained 2.17 per cent. potash. Cost $12 per ton.

If potash is valued at 30 cents per pound, the price current in the spring of 1919, the valuation of the potash alone about covers the cost of the fertilizer.

Wood ashes have been used considerably as a source of potash on the tobacco crop being bought at $6 to $6.30 per unit of potash which is equivalent to 30 to 32½ cents per pound. Analyses of wood ashes are given on later pages of this report.

NITRAPO.

With the potash salts may be classed this material, offered by the Nitrate Agencies Co. of New York City. It is stated to be a product of refineries in Chili.

12703. Sent by the Hartford county agricultural agent. It contains 14.52 per cent. of nitrogen and 19.94 per cent. of potash. It contains less than one-half per cent. of chlorine and no borax. The price quoted is $175 per ton in New York. Allowing 31½ cents per pound for nitrogen the potash costs 41.3 cents per pound or $8.26 per unit.

IV. CONTAINING NITROGEN AND PHOSPHORIC ACID.

FISH MANURES.

Fifteen analyses of this material appear in the table. In only one, **12841**, is the nitrogen less than was guaranteed but four failed to meet the guaranty of phosphoric acid.

13509 is fish bought in the previous year.

The six other samples of which the prices are given and the composition is normal have the following average composition:

Nitrogen	8.36
"Available" phosphoric acid	7.45
Insoluble phosphoric acid	3.04
Cost per ton	$101.00

If the "available" phosphoric acid is valued at 10½ cents per pound, its cost in acid phosphate, and the insoluble phosphoric acid at 4 cents, the average cost of nitrogen in fish manures has been about 49.6 cents per pound.

ANALYSES OF

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.
	Sampled by Station:	
12731	American Agr. Chem. Co.	Jacob Lang, Windsor
12672	Apothecaries Hall Co.	H. B. Cornwall, Meriden
12692	Berkshire Fertilizer Co.	Max Lavitt, Ellington
12720	L. T. Frisbie Co.	Frisbie Branch, Hartford
12863[1]	A. L. Koster, Suffield	Am. Sumatra Tob. Co., Win. Loc
12968[2]	A. L. Koster, Suffield	Michael Cannon, Ellington
13509	Russia Cement Co., Boston	Griffin Tobacco Co., Bloomfield
12923	Olds & Whipple	Manufacturer
12943	Va.-Car. Chemical Co.	S. J. Stevens, Glastonbury
	Sampled by Purchaser:	
12755	A. Manning, South Manchester	Jos. Prekop, West Suffield
12470		E. J. Eaton, New London
12601	A. W. Higgins, S. Deerfield, Mass.	Aaron Dobkin, Ellington
12841	A. L. Koster, Suffield	Fassler & Silberman, Hartford
12423		Am. Sumatra Tob. Co., E. Hartfo
12666		L. J. Prior, East Hartford

[1] Chlorine 0.24 [2] Chlorine 0.15

SLAUGHTER HOUSE TANKAGE.

Of the seven samples drawn by the station six represent products low in nitrogen. *(For analyses see page 70.)*

The three samples from Meriden, made by C. M. Shay Co., are much below their guaranty of nitrogen.

If the phosphoric acid in these samples is valued at 6 cents, the average cost of nitrogen is about 42.1 cents. If on the other hand nitrogen is reckoned worth 49.6 cents per pound, as in fish scrap, the phosphoric acid costs 4.1 cents.

MIXED BONE AND TANKAGE.

12978. Listers Celebrated Ground Bone and Tankage Acidulated, made by Listers Agricultural Chemical Works, Newark, N. J. From stock of G. C. Neal, Hamden. *(For analysis see page 70.)*

Fish Manures.

Nitrogen.				Phosphoric acid.			Total phosphoric acid.		
As ammonia.	As organic.	Total found.	Total guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Cost per ton.
0.37	5.97	6.34	5.76	0.40	3.92	0.95	5.27	5.50	......
0.10	8.15	8.25	8.20	0.23	8.09	5.37	13.69	5.50	$100.00
0.25	7.38	7.63	7.40	0.64	6.16	0.91	7.71	7.00	105.00
0.21	8.12	8.33	7.41	0.27	5.89	1.34	7.50	14.00	90.00
0.12	8.42	8.54	8.23	0.29	3.02	0.55	3.86	5.00	......
....	....	8.38	8.23	0.31	2.02	0.82	3.15	5.00	......
0.10	7.95	8.05	....	0.51	8.23	7.01	15.75	....	50.00
0.13	8.03	8.16	8.23	0.42	7.19	4.43	12.04	5.50	110.00
0.12	9.14	9.26	8.20	0.45	5.47	1.32	7.24	2.00	100.00
0.60	4.77	5.37	....	0.62	6.80	3.22	10.64	10.00	70.00
0.10	9.84	9.94	....	0.63	1.04	0.52	2.19	....	......
0.12	8.39	8.51	7.00	0.36	9.54	4.84	14.74	16.00	100.00
....	....	7.38	8.23	0.28	3.59	0.83	4.70	5.00	......
0.12	8.69	8.81	....	0.51	5.02	1.80	7.33	....	......
0.05	7.10	7.15	....	0.63	6.93	7.36	14.92	....	......

ANALYSES OF

Station No.	Manufacturer.	Dealer or Purchaser.
	Sampled by Station:	
12670	Apothecaries Hall Co.	H. B. Cornwall, Meriden
12735	Armour Fertilizer Works	Quality Seed Store, Stamford
12671	F. O. Brown, Leonards Bridge	Meriden Farmers' Exchange
12719	Conn. Fat Rend. & Fertz. Co.	Manufacturer
12790	C. M. Shay Co.	Peter Levine, Meriden
13367	C. M. Shay Co.	Chas. T. Kinney, Meriden
13368	C. M. Shay Co.	W. T. Rice, South Meriden
	Sampled by Purchaser:	
12431	Allison Bros., Middletown	Raymond J. Harris, Middletown.
12676		Rhett Fletcher, Mount Carmel

PERCENTAGE COMPOSITION OF MIXED BONE AND TANKAGE.

Total nitrogen found	2.53
Total nitrogen guaranteed	2.67
Total phosphoric acid found	10.98
Total phosphoric acid guaranteed	12.00
Finer than 1-50	62.00
Coarser than 1-50	38.00

BONE MANURES.

(ANALYSES ON PAGE 72.)

All of the sixteen brands examined substantially meet their guaranties. In twelve brands more than 50 per cent. of the bone was finer than 1-50 inch.

The average cost of all the brands was $58.27 per ton. If nitrogen is given a value of 49.6 cents a pound, as in cotton seed meal, a pound of phosphoric acid cost 5.2 cents.

If phosphoric acid is valued at 6 cents, nitrogen costs 43.8 cents.

Following is a statement of the *approximate* average prices which have been paid in this state for nitrogen, phosphoric acid and potash during the spring of 1919.

SLAUGHTER HOUSE TANKAGE.

Nitrogen.				Phosphoric acid.		Mechanical analysis.		
As ammonia.	As organic.	Total found.	Total guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	Cost per ton.
0.18	3.72	3.90	3.29	21.77	20.00	42.0	58.0	$55.00
0.25	7.30	7.55	7.40	7.77	6.87	41.0	59.0	80.00
0.13	5.32	5.45	4.92	15.67	14.00	37.0	63.0	57.00
0.31	2.82	3.13	3.00	22.85	20.00	58.0	42.0	45.00
0.34	3.14	3.48	5.00	19.32	15.00	55.0	45.0	57.00
0.37	3.64	4.01	5.00	17.09	16.00	49.0	51.0	....
0.30	3.52	3.82	5.00	18.48	16.00	57.0	43.0	....
0.12	6.72	6.84	....	12.29	....	45.0	55.0	45.00
....	....	3.78	....	22.90	....	62.0	38.0	....

	Cents per pound.
Nitrogen in nitrate of soda, 29 to 35	31.5
sulphate of ammonia	23.9
cotton seed meal	40.5
castor pomace	47.1
fish	49.6
tankage	42.1
bone	43.8
Total phosphoric acid in ground apatite	5.7 to 7.5
Florida rock	9.1
Available phosphoric acid in precipitated bone	8.0
basic lime phosphate	8.7 to 9.8
acid phosphate	10.5
Potash in cotton hull ashes	30.0
wood ashes	30 to 32.5
from cement manufacture	24 to 28
in "Nitrapo"	41.3

V. MIXED FERTILIZERS.

NITROGENOUS SUPERPHOSPHATES WITHOUT POTASH.

In a following table are 166 analyses representing nearly all the brands of this class offered for sale in this state in 1919.

ANALYSES OF

Station No.	Manufacturer and Brand.	Dealer or Purchas
	Sampled by Station:	
12985	Am. Agr. Chem. Co., Fine Ground Bone	W. C. Mansfield, North
12984	Amer. Agr. Chem. Co., High Grade Ground Bone	J. A. Glasnapp, West Ch
12983	Armour Fertz. Works, Bone Meal	F. S. Bidwell & Co., Wi
12982	Berkshire Fertz. Co., Ground Bone	Max Lavitt, Ellington ..
12981	Coe-Mortimer Co., Fine Ground Bone....	J. P. Barstow & Co., Nor
12980	L. T. Frisbie Co., Fine Bone Meal	F. S. Platt & Co., New Ha
12979	Listers Agr. Chem. Works, Bone Meal	Paul Lanz, Rockville ....
2974	Pawtucket Ren. Co., Pure Ground Bone	A. D. Briggs, Pomfret ...
2880	Rogers & Hubbard Co., Pure Raw Knuckle Bone Flour	Cadwell & Jones, Hartford
2967	Rogers & Hubbard Co., Strictly Pure Fine Bone	David Bros., Durham .....
977	F. S. Royster Guano Co., Fine Ground Bone Meal	Silliman Hdw. Co., New Ca
976	Sanderson Fertz. & Chem. Co., Fine Ground Bone	Manufacturer ....
134	M. L. Shoemaker & Co., Swift Sure Bone Meal	Olds & Whipple, Hartford ..
34	Springfield Ren. Co., Fine Ground Bone	G. S. Phelps & Co., Thompso
59	Van Iderstine Co., Pure Ground Bone..	E. B. Clark Seed Co., Milfor
75	Worcester Rend. Co., Royal Worcester Pure Fine Ground Bone	F. M. Cole, Putnam ....

COMPOSITION AND COST OF THE BRANDS.

In almost all cases excepting those having 4.11 per cent. of nitrogen (5 per cent. ammonia) or more, either 8 or 10 per cent. of available phosphoric acid is guaranteed.

13 samples have a guaranty of .82 per cent. nitrogen.
21 " " " " " 1.65 " "
23 " " " " " 2.47 " "
26 " " " " " 3.29 " "
36 " " " " " 4.11 " "
8 " " " " " 5.53 " "
9 " " " still higher nitrogen guaranty.
30 " unclassified.
—
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BONE MANURES.

Nitrogen.		Phosphoric acid.		Mechanical analysis.		
Found.	Guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	Cost per ton.
3.43	2.47	24.51	22.89	65.0	35.0	.....
3.38	3.29	23.08	20.50	70.0	30.0	$56.00
2.80	2.47	25.07	22.00	60.0	40.0	59.00
3.76	3.30	22.34	20.00	36.0	64.0	60.50
2.67	2.47	22.26	22.35	59.0	41.0	58.00
3.25	2.46	23.85	20.00	32.0	68.0	55.00
3.78	2.47	23.56	23.00	64.0	36.0	56.50
3.05	2.47	25.25	23.00	64.0	36.0	48.00
3.90	3.82	25.28	24.70	68.0	32.0	70.00
3.58	3.29	22.06	20.59	58.0	42.0	62.00
2.47	2.47	24.36	22.90	51.0	49.0	59.00
3.06	2.47	25.07	22.00	49.0	51.0	50.00
5.20	5.14	23.69	20.88	74.0	26.0	66.50
3.36	2.46	25.23	23.00	65.0	35.0	54.00
2.26	2.00	28.86	27.00	48.0	52.0	.....
3.41	2.47	22.06	23.00	57.0	43.0	53.00

Comparing brands containing the same amount of available phosphoric acid but different amounts of nitrogen, it is possible to approximately determine the average cost price of nitrogen. Thus 11 brands with 10 per cent. available phosphoric acid contain 0.82 per cent. and cost $41.14; 19 contain 1.65 nitrogen and cost $49.77; .82 per cent. or 16.4 lbs. of nitrogen in the ton cost $49.77 — $41.14 = $8.63 ÷ 16.4 = 52 cents per pound for nitrogen. Rising from a guaranty of 1.65 per cent. nitrogen to 2.47 per cent., nitrogen costs 32.3 cents. Rising from 2.47 per cent. to 3.29 per cent., nitrogen costs 36.4 cents.

It is clear, as has always been contended by the station, that the higher grade fertilizers, notwithstanding their higher price, are the more economical.

GUARANTIES.

Fifteen samples contained less nitrogen than was guaranteed, and 12 contained less phosphoric acid.

In most cases, however, the money value of the deficiency in one ingredient was made good by an overrun in the other.

Eight samples failed to thus make good by the amounts given below, valuing nitrogen at 45 cents per pound and available phosphoric acid at 10 cents.

12959	Bradley's Special Potato Manure	$2.42
12916	Armour's Special Tobacco Grower	1.91
12715	Coe-Mortimer's Top Dressing Manure, 1916	2.13
12534	Lowell Potato Phosphate	2.83
12835	Mapes General Crop, 1916	2.58
12843	National Nitrogen Phosphate Mixture No. 5	4.83
12776	Royster's Landmark Ammoniated Phosphate	5.14
12925	Royster's Penguin Ammoniated Phosphate	1.31

But of Armour's Special Tobacco Grower, a second sample which fully met its guaranty was drawn from another source.

A second sample of Coe-Mortimer's Top Dressing Manure 1916 was also found to meet its guaranty. The same is true of Royster's Penguin Ammoniated Phosphate as appears from the analysis in the table.

QUALITY OF THE NITROGEN.

The solubility of the water-insoluble nitrogen in all factory mixtures has been determined by the permanganate methods of Jones and Street. In the following brands the presence of inferior forms of nitrogen was indicated by both methods:

12520 Atlantic Packing Co.'s Grain Fertilizer.
12783 Berkshire Fertilizer Co.'s Grass Special.
12612 Berkshire Fertilizer Co.'s Potato and Vegetable Phosphate.
12597 Berkshire Fertilizer Co.'s Root Fertilizer.
12717 Coe-Mortimer Co.'s Tobacco Special.
12531 Lowell Fertilizer Co.'s Potato Manure.
12849 New England Fertilizer Co.'s Corn and Grain Fertilizer.
12848 New England Fertilizer Co.'s Standard Phosphate.
13031 Rogers & Hubbard Co.'s Bone Base Soluble Corn and General Crops.

The Berkshire Fertilizer Co. explains that their formulas were calculated to furnish the full amount of nitrogen necessary to meet their guaranties in available form *without counting the nitrogen in garbage tankage* which was added as a conditioner or dryer. To such use of garbage tankage or other conditioner no objection is made, but in these cases the formulas did not meet the guaranties without counting in the inferior nitrogen of the conditioner.

Analyses Needing Special Notice.

12700, Atlantic Packing Co.'s Tobacco Special was below guaranty in nitrogen and far above it in available phosphoric acid. The manufacturer objected that this did not fairly represent the composition of this brand. A second sample of this brand was therefore drawn and analyzed, **12953**, which fully met the guaranty.

12778, the above firm's Top-Dresser, was deficient in nitrogen. The manufacturer showed that this was stock carried over from the previous season. Another sample, representing the present season's output, **12986**, also showed a slight deficiency of nitrogen.

13156, Coe-Mortimer's Top-Dressing Manure, 1916, being found deficient in available phosphoric acid, a portion of our sample was sent to the manufacturer's chemist whose analysis differs from ours in these respects:

	Station figures.	Manufacturer's figures.
Available phosphoric acid	7.33	7.74
Total phosphoric acid	8.55	9.08

Frequently manufacturers have called for portions of our samples for their own test, but in all other cases so far as reported their results and ours have substantially agreed. We cannot explain the discrepancy in this case.

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	American Agricultural Chem. Co., New York City.	
12591	Ammoniated Fertilizer A	Milford
12590	Ammoniated Fertilizer AA	Milford
12756	Ammoniated Fertilizer AAA	Milford
12592	Ammoniated Fertilizer AAAA	Southport
12955	Complete Tobacco Manure without Potash	Ellington
12511	5–8 Fertilizer	New Haven
12957	Odorless Grass and Lawn Top Dressing without Potash	Ellington
12757	Odorless Grass and Lawn Top Dressing without Potash	Stafford Springs
12956	Special Vegetable Fertilizer	Ellington
12593	Tobacco Special	Glastonbury
12644	Bradley's Grain Fertilizer	Putnam
12759	Bradley's Root Crop Manure	Groton
12645	Bradley's Special Corn Phosphate without Potash	Norwich
12959[1]	Bradley's Special Potato Manure without Potash	Groton
12646	Bradley's Special Potato Fertilizer without Potash	Groton
12512	Bradley's Tobacco Manure without Potash	Suffield
12763	East India Tobacco Special without Potash	Gaylordsville
12648	Quinnipiac Special Corn Manure without Potash	New London
12766	Quinnipiac Special Potato Phosph. without Potash	New London
12767	Quinnipiac Wrapper Leaf Brand Manure without Potash	Hazardville
12912	Williams and Clark's Seed Leaf Tobacco Manure without Potash	South Manchester
12910	Williams and Clark's Special Americus Corn Phosphate without Potash	Ellington
12911	Williams and Clark's Special Americus Potato Manure without Potash	Ellington
	Apothecaries Hall Co., Waterbury, Conn.	
12698	Liberty Corn, Fruit and All Crops	Windsorville
12699	Liberty Market Gardeners' Special	Windsorville
12779	Liberty Potato and Vegetable Special	Windsorville
12780	Liberty Tobacco Special	Windsorville
12954	Liberty Tobacco Special	Windsorville
12594	Liberty Top Dresser for Grass and Grain	Milldale
	Armour Fertilizer Works, Chrome, N. J.	
12916[1]	Special Tobacco Grower No. 2	South Manchester
13157	Special Tobacco Grower No. 2	Agawam, Mass.
12611	2–10–0	Rockville
12516	4–10–0	Windsor Locks

[1] See note, page 74.

WITHOUT POTASH.

Nitrogen.						Phosphoric Acid.							
				Total.					Total.		So-called "Available."		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.14	0.15	0.11	0.74	1.14	0.82	7.20	3.86	0.93	11.99	11.00	11.06	10.00	12591
....	0.56	0.19	1.00	1.75	1.65	7.58	2.88	1.02	11.48	11.00	10.46	10.00	12590
....	1.12	0.34	1.14	2.60	2.47	8.94	2.11	0.83	11.88	11.00	11.05	10.00	12756
1.29	0.94	0.34	0.87	3.44	3.29	8.38	2.17	0.86	11.41	11.00	10.55	10.00	12592
1.07	0.08	0.06	3.40	4.61	4.53	1.10	3.45	0.27	4.82	4.00	4.55	3.00	12955
0.93	1.90	0.14	1.12	4.09	4.11	7.10	1.54	0.79	9.43	9.00	8.64	8.00	12511
1.49	1.34	0.13	1.34	4.30	4.11	6.31	3.46	1.33	11.10	11.00	9.77	10.00	12957
1.80	1.22	0.29	0.77	4.08	4.11	6.70	3.26	1.43	11.39	11.00	9.96	10.00	12757
1.07	1.14	0.07	1.15	3.43	3.29	6.34	3.60	1.42	11.36	11.00	9.94	10.00	12956
0.99	0.24	0.04	3.08	4.35	4.11	1.34	4.36	0.35	6.05	5.00	5.70	4.00	12593
....	0.36	0.14	0.54	1.04	0.82	6.12	3.64	0.90	10.66	11.00	9.76	10.00	12644
0.92	1.46	....	1.07	3.45	3.29	7.25	3.06	1.22	11.53	11.00	10.31	10.00	12759
0.27	0.63	....	0.91	1.81	1.65	6.15	4.43	1.32	11.90	11.00	10.58	10.00	12645
0.34	0.78	0.10	0.97	2.19	2.47	6.54	3.51	1.05	11.10	11.00	10.05	10.00	12959
0.05	0.65	0.17	0.90	1.77	1.65	5.92	4.34	1.47	11.73	11.00	10.26	10.00	12646
1.04	0.17	....	3.25	4.46	4.53	0.68	4.26	0.38	5.32	4.00	4.94	3.00	12512
0.81	0.36	0.24	3.05	4.46	4.53	0.98	3.88	0.50	5.36	4.00	4.86	3.00	12763
0.09	0.63	0.07	1.01	1.80	1.65	6.59	4.05	0.77	11.41	11.00	10.64	10.00	12648
0.15	0.63	0.05	0.98	1.81	1.65	7.02	3.88	0.87	11.77	11.00	10.90	10.00	12766
0.93	0.07	0.08	3.49	4.57	4.53	1.73	3.31	0.22	5.26	4.00	5.04	3.00	12767
0.85	0.44	0.12	3.29	4.70	4.53	0.89	4.21	0.51	5.61	4.00	5.10	3.00	12912
....	0.85	0.21	0.81	1.87	1.65	5.52	4.42	2.43	12.37	11.00	9.94	10.00	12910
0.14	0.81	0.03	0.78	1.76	1.65	5.62	4.53	2.48	12.63	11.00	10.15	10.00	12911
0.11	0.15	0.36	1.38	2.00	1.65	6.91	2.65	0.41	9.97	11.00	9.56	10.00	12698
....	1.31	0.62	1.57	3.50	3.29	8.99	2.05	0.63	11.67	11.00	11.04	10.00	12699
....	0.73	0.52	1.38	2.63	2.47	8.35	2.18	0.31	10.84	11.00	10.53	10.00	12779
0.25	2.00	....	1.61	3.86	4.11	3.41	1.66	0.24	5.31	5.00	5.07	4.00	12780
0.27	2.01	....	1.74	4.02	4.11	3.35	1.56	0.31	5.22	5.00	4.91	4.00	12954
1.89	1.71	0.22	1.08	4.90	4.94	6.94	1.68	0.28	8.90	9.00	8.62	8.00	12594
0.79	0.09	0.10	2.64	3.62	4.11	3.02	2.23	2.48	7.73	4.50	5.25	4.00	12916
0.29	2.06	1.78		4.13	4.11	2.94	2.07	0.17	5.18	4.50	5.01	4.00	13157
0.16	0.81	0.09	0.65	1.71	1.65	6.37	3.04	1.54	10.95	10.50	9.41	10.00	12611
0.24	1.60	0.22	1.23	3.29	3.29	8.05	2.18	0.95	11.18	10.50	10.23	10.00	12516

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling
	Sampled by Station:	
	Atlantic Packing Co., New Haven, Conn.	
12520[1]	Grain Fertilizer	New Haven
12519	Potato Phosphate	New Haven
12701	Special Vegetable	New Haven
12700[2]	Tobacco Special (C. S. Meal)	South Windsor
12953	Tobacco Special (C. S. Meal)	Burnside
12778[2]	Top Dresser	New Haven
12986[2]	Top Dresser	Factory
	Berkshire Fertilizer Co., Bridgeport, Conn.	
12690	Ammoniated Bone Phosphate	Norwichtown
12783[1]	Grass Special	Ellington
12613	Market Garden Fertilizer	Ellington
12612[1]	Potato and Vegetable Phosphate	Centerbrook
12597[1]	Root Fertilizer	Wethersfield
12691	Tobacco Grower	Ellington
12784	Tobacco Starter	Suffield
	F. E. Boardman, Middletown, Conn.	
12808	Fertilizer for General Crops	Factory
	Bowker Fertilizer Co., New York City.	
12696	Four Ten Hill and Drill	Willimantic
12693	One Ten Sure Crop	Yantic
12787	Superphosphate with Ammonia 1%	Terryville
12522	Superphosphate with Ammonia 2%	Yalesville
12598	Superphosphate with Ammonia 3%	Plainville
12695	Superphosphate with Ammonia 4%	Yalesville
12786	Superphosphate with Ammonia 5%	Simsbury
12614	Three Ten All Round	Rockville
12435	Tobacco Grower 1916	Thompsonville
12694	Two Ten Farm and Garden	Norwich
	F. O. Brown, Leonard's Bridge, Conn.	
12806	Vegetable and Potato Grower	Farmington
12807	Oats and Top Dressing	Farmington
	E. D. Chittenden Co., Bridgeport, Conn.	
12804	Complete Tobacco and Onion Grower without Potash	Enfield
12600	Vegetable and Onion Grower without Potash	Greens Farms
	E. B. Clark Seed Co., Milford, Conn.	
12711	Special Mixture for General Use	Factory

[1] See note, page 74. [2] See note, page 75.

WITHOUT POTASH—(*Continued*).

Nitrogen.						Phosphoric Acid.							
				Total.					Total.		So-called "Available."		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.19	0.74	0.28	0.49	1.70	1.64	7.25	3.60	0.50	11.35	11.00	10.85	10.00	12520
....	0.96	0.61	0.85	2.42	2.46	6.55	3.92	0.79	11.26	11.00	10.47	10.00	12519
1.23	0.25	0.83	1.00	3.31	3.26	5.81	5.31	2.41	13.53	11.00	11.12	10.00	12701
1.15	0.08	0.96	1.65	3.84	4.10	3.91	4.63	1.57	10.11	7.00	8.54	6.00	12700
1.07	0.14	1.06	1.83	4.10	4.10	3.01	4.93	2.24	10.18	8.00	7.94	6.00	12953
0.73	1.87	0.42	0.88	3.90	4.10	5.56	3.35	0.52	9.43	9.00	8.91	8.00	12778
0.71	1.14	0.99	1.14	3.98	4.10	5.69	3.49	0.70	9.88	9.00	9.18	8.00	12986
0.03	0.59	0.10	0.37	1.09	0.80	4.65	5.63	0.79	11.07	11.00	10.28	10.00	12690
3.15	1.07	0.04	0.48	4.74	5.00	4.09	1.56	0.38	6.03	5.00	5.65	4.00	12783
0.74	1.50	0.14	0.96	3.34	3.30	7.84	1.87	0.49	10.20	9.00	9.71	8.00	12613
....	0.86	0.35	0.59	1.80	1.70	2.88	8.70	1.15	12.73	11.00	11.58	10.00	12612
1.08	0.90	0.15	0.48	2.61	2.50	3.70	4.66	0.63	8.99	9.00	8.36	8.00	12597
0.83	0.98	0.24	1.86	3.91	4.11	1.82	2.83	0.28	4.93	4.00	4.65	3.00	12691
2.45	0.62	0.60	1.35	5.02	5.00	3.05	1.93	0.28	5.26	5.00	4.98	4.00	12784
0.69	1.35	0.33	0.91	3.28	3.29	4.91	3.03	0.54	8.48	....	7.94	7.00	12808
0.84	1.48	0.16	1.02	3.50	3.29	7.31	2.87	1.27	11.45	11.00	10.18	10.00	12696
....	0.32	0.13	0.58	1.03	0.82	6.51	3.89	0.81	11.21	11.00	10.40	10.00	12693
....	0.03	0.34	0.46	0.83	0.82	7.04	3.30	1.25	11.59	11.00	10.34	10.00	12787
....	0.44	0.32	0.89	1.65	1.65	7.10	2.93	1.61	11.64	11.00	10.03	10.00	12522
....	0.85	0.39	1.27	2.51	2.47	8.78	2.01	0.65	11.44	11.00	10.79	10.00	12598
0.90	1.46	....	1.02	3.38	3.29	8.19	1.97	0.97	11.13	11.00	10.16	10.00	12695
0.30	1.44	0.83	1.67	4.24	4.11	4.03	4.32	2.60	10.95	9.00	8.35	8.00	12786
....	1.15	0.37	1.11	2.63	2.47	8.74	1.71	1.41	11.86	11.00	10.45	10.00	12614
1.01	....	0.11	3.15	4.27	4.11	1.10	4.[illegible]4	0.28	6.12	5.00	5.84	4.00	12435
0.64	0.13	0.19	0.72	1.68	1.65	2.21	7.89	2.01	12.11	11.00	10.10	10.00	12694
0.61	0.85	0.58	0.86	2.90	2.87	7.07	3.93	0.82	11.82	11.00	11.00	10.00	12806
0.80	0.95	1.23	1.40	4.38	4.10	5.50	3.61	0.57	9.68	9.00	9.11	8.00	12807
1.95	1.23	0.03	0.40	3.61	3.29	6.60	3.93	1.62	12.15	11.00	10.53	10.00	12804
0.65	1.25	0.08	0.57	2.55	2.46	7.25	3.23	1.29	11.77	11.00	10.48	10.00	12600
0.07	2.21	0.27	1.20	3.75	3.25	8.92	2.86	1.41	13.19	12.00	11.78	10.00	12711

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling
	Sampled by Station:	
	The Coe-Mortimer Co., New York City.	
12714	Excelsior Potato Fertilizer 1916	Greenwich
12524	High Grade Ammoniated Superphosphate 1916	Milford
12713	Prolific Crop Producer 1916	Abington
12717[1]	Tobacco Special	Rockville
12715[1]	Top Dressing Manure 1916	Poquonock
13156[2]	Top Dressing Manure 1916	Somerville
	The Essex Fertilizer Co., Boston, Mass.	
12638	Fish Fertilizer	Rockville
12615	Grain, Grass and Potato Fertilizer	South Manchester
12811	Market Garden	North Haven
12799	Potato Phosphate	Hartford
12812	Special Tobacco 5-4	Rockville
12853	Tobacco Manure 5-6	Granby
	The L. T. Frisbie Co., New Haven, Conn.	
12525	Connecticut Special for All Crops	Meriden
12721	Corn and Grain Fertilizer	New London
12860	One Ten	Norwich
12616	Market Garden and Top Dresser	Rockville
12526	Potato and Vegetable Grower	Guilford
12569	Tobacco Special	Glastonbury
	International Agricultural Corp., Buffalo, N. Y.	
12814	Buffalo Farmers' Choice	Moosup
12820	Buffalo Garden Truck	West Cheshire
12816	Buffalo New England Special	Southington
12433	Buffalo Onion, Vegetable and Potato	Thompsonville
12818	Buffalo Tobacco Grower	West Suffield
12819	Buffalo Tobacco Special	Enfield
	A. L. Koster, Suffield, Conn.	
12864	A. S. T. Special Corn Fertilizer	East Hartford
	Lister's Agricultural Chemical Works, Newark, N. J.	
12921	Celebrated Tobacco Fertilizer without Potash	Warehouse Point
12865	Complete Tobacco Fertilizer without Potash	Burnside
12529	Plant Food 1916	Yalesville
12821	Superior Ammoniated Superphosphate 1916	Danbury
	Lowell Fertilizer Co., Boston, Mass.	
12833	Animal Brand	Wallingford
12922	Bone Fertilizer	Southington

[1] See note, page 74. [2] See note, page 75.

WITHOUT POTASH—(*Continued*).

Nitrogen.						Phosphoric Acid.							
				Total.					Total.		So-called "Available."		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
1.66	1.25	0.02	1.17	4.10	4.11	7.77	2.59	1.20	11.56	11.00	10.36	10.00	12714
...	1.27	0.63	0.96	2.86	2.47	7.61	3.37	0.46	11.44	11.00	10.98	10.00	12524
1.43	0.97	0.21	0.93	3.54	3.29	6.60	3.43	1.02	11.05	11.00	10.03	10.00	12713
0.87	0.60	none	2.64	4.11	4.11	1.74	4.57	0.60	6.91	5.00	6.31	4.00	12717
2.43	2.85	0.12	0.65	6.05	6.58	7.20	2.12	0.38	9.70	9.00	9.32	8.00	12715
2.94	2.75	0.93		6.62	6.58	4.49	2.84	1.22	8.55	9.00	7.33	8.00	13156
...	0.95	0.57	0.87	2.39	2.46	6.92	4.23	0.72	11.87	11.00	11.15	10.00	12638
0.07	0.08	0.42	0.48	1.05	0.82	8.06	2.65	1.42	12.13	11.00	10.71	10.00	12615
0.56	0.92	0.57	0.73	2.78	2.87	7.53	3.92	0.27	11.72	11.00	11.45	10.00	12811
0.71	1.27	0.50	0.77	3.25	3.29	7.02	4.07	1.27	12.36	11.00	11.09	10.00	12799
1.38	0.10	1.00	1.85	4.33	4.10	1.21	5.64	1.36	8.21	5.00	6.85	4.00	12812
1.52	0.12	1.07	1.72	4.43	4.10	3.46	4.91	1.33	9.70	7.00	8.37	6.00	12853
...	0.88	0.97	0.63	2.48	2.46	6.87	4.24	0.70	11.81	11.00	11.11	10.00	12525
0.13	0.73	0.29	0.54	1.69	1.64	6.74	4.37	0.56	11.67	11.00	11.11	10.00	12721
0.17	0.21	0.20	0.33	0.91	0.82	7.78	3.61	0.27	11.66	11.00	11.39	10.00	12860
0.98	0.98	1.19	1.08	4.23	4.11	5.68	3.42	0.75	9.85	9.00	9.10	8.00	12616
0.36	1.13	0.77	1.02	3.28	3.28	7.27	3.63	0.77	11.67	11.00	10.90	10.00	12526
1.17	0.09	1.05	1.77	4.08	4.10	2.94	3.21	1.74	7.89	7.00	6.15	6.00	12569
0.35	0.19	0.03	0.62	1.19	0.80	7.94	4.34	1.18	13.46	11.00	12.28	10.00	12814
1.18	0.51	0.49	1.30	3.48	3.30	7.70	2.81	1.05	11.56	11.00	10.51	10.00	12820
0.75	0.20	0.17	0.66	1.78	1.60	6.48	3.83	1.09	11.40	11.00	10.31	10.00	12816
0.96	0.53	0.15	1.03	2.67	2.50	7.07	3.54	1.59	12.20	11.00	10.61	10.00	12433
1.08	1.11	0.20	1.82	4.21	4.10	0.76	3.61	1.04	5.41	5.00	4.37	4.00	12818
0.70	0.50	0.19	2.06	3.45	3.30	0.84	3.11	0.72	4.67	4.00	3.95	3.00	12819
0.17	2.59	0.03	1.74	4.53	4.10	7.11	2.05	0.67	9.83	10.00	9.16	8.00	12864
1.03	0.05	0.15	2.78	4.01	4.53	1.58	2.50	0.15	4.23	4.00	4.08	3.00	12921
1.03	1.03	0.76	1.11	3.93	4.11	2.43	2.32	0.97	5.72	5.00	4.75	4.00	12865
....	0.14	0.50	0.43	1.07	0.82	6.82	3.44	1.70	11.96	11.00	10.26	10.00	12529
1.43	1.45	0.26	0.51	3.65	3.29	8.13	2.12	0.79	11.04	11.00	10.25	10.00	12821
0.07	0.87	0.82	1.23	2.99	2.87	7.12	4.22	1.94	13.28	11.00	11.34	10.00	12833
0.10	0.07	1.00	0.87	2.04	2.06	6.82	3.79	1.75	12.36	11.00	10.61	10.00	12922

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	Lowell Fertilizer Co., Boston, Mass. (*Continued.*)	
12832	Empress Brand	Saybrook
12535	Potato, Corn and Vegetable	Warehouse Point
12531[1]	Potato Manure	Wallingford
12534[1]	Potato Phosphate	Suffield
12834	Tobacco Grower	Warehouse Point
	The Mapes Formula and Peruvian Guano Co., New York City.	
12837	C. S. Special without Potash	Hartford
12835[1]	General Crop 1916	Windsor Locks
	National Fertilizer Co., New York City.	
12427	Five Four Tobacco Manure	Somers
12545	Five Four Tobacco Manure	Silver Lane
12539	Nitrogen Phosphate Mixture No. 1	Guilford
12541	Nitrogen Phosphate Mixture No. 2	Wallingford
12842	Nitrogen Phosphate Mixture No. 3	Willimantic
12540	Nitrogen Phosphate Mixture No. 4	Guilford
12843[1]	Nitrogen Phosphate Mixture No. 5	Windsorville
12844	Tobacco Special without Potash	Rockville
	New England Fertilizer Co., Boston, Mass.	
12849[1]	Corn and Grain Fertilizer	Norwich
12542	Potato Fertilizer	Meriden
12850	Special Tobacco Manure	Hazardville
12848[1]	Standard Phosphate	Rockville
12543	Superphosphate	North Haven
12851	Tobacco Grower 5-4	Warehouse Point
	Nitrate Agencies Co., New York City.	
12852	4-10 Universal Mixture	Milford
	Olds and Whipple, Hartford, Conn.	
12576	Special Grass Fertilizer (less Potash)	Factory
12428	Special High Grade Tobacco Starter	Somers
12544	Special Onion, Corn and Potato Fertilizer	Factory
12870	Special Phosphate	Factory
12429	Tobacco Special Fertilizer	Somers
	Parmenter and Polsey Fertilizer Co., Boston, Mass.	
12872	Plymouth Rock Brand	Highwood
12873	Special Tobacco	Warehouse Point
12871	Star Brand Superphosphate	Highwood

WITHOUT POTASH—(*Continued*).

Nitrogen.						Phosphoric Acid.							
				Total.					Total.		So-called "Available."		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.10	0.10	0.57	0.64	1.41	1.23	7.37	3.56	1.79	12.72	11.00	10.93	10.00	12832
0.83	0.99	1.02	1.14	3.98	4.10	5.94	3.57	0.70	10.21	9.00	9.51	8.00	12535
....	0.96	0.83	0.86	2.65	2.46	6.81	3.82	1.69	12.32	11.00	10.63	10.00	12531
0.63	0.95	0.54	0.68	2.80	3.29	7.27	3.52	1.04	11.83	11.00	10.79	10.00	12534
1.52	0.11	0.86	1.66	4.15	4.11	3.65	4.46	1.55	9.66	7.00	8.11	6.00	12834
0.81	1.11	0.21	2.16	4.29	4.12	0.39	3.94	0.79	5.12	4.00	4.33	4.00	12837
0.63	0.43	....	0.58	1.64	1.65	0.86	5.85	4.55	11.26	10.00	6.71	8.00	12835
0.96	0.52	2.76		4.24	4.11	1.21	4.28	0.42	5.91	5.00	5.49	4.00	12427
1.05	0.09	....	2.97	4.11	4.11	2.05	3.02	0.46	5.53	5.00	5.07	4.00	12545
....	0.07	0.15	0.79	1.01	0.82	5.49	4.82	0.70	11.01	11.00	10.31	10.00	12539
....	0.08	0.38	1.20	1.66	1.65	7.21	3.07	1.82	12.10	11.00	10.28	10.00	12541
0.47	1.14	0.04	0.96	2.61	2.47	6.62	3.70	1.60	11.92	11.00	10.32	10.00	12842
0.94	1.40	0.14	0.95	3.43	3.29	7.44	3.43	0.99	11.86	11.00	10.87	10.00	12540
0.50	1.15	0.52	1.29	3.46	4.11	2.74	5.77	2.53	11.04	9.00	8.51	8.00	12843
0.78	0.23	0.06	3.30	4.37	4.53	1.08	3.90	0.52	5.50	4.00	4.98	3.00	12844
0.05	0.12	0.50	0.60	1.27	1.23	7.26	3.69	2.11	13.06	11.00	10.95	10.00	12849
0.19	0.86	0.72	0.79	2.56	2.46	6.74	3.71	1.52	11.97	11.00	10.45	10.00	12542
1.27	0.12	0.96	1.86	4.21	4.10	3.09	5.47	1.73	10.29	7.00	8.56	6.00	12850
0.08	0.07	0.32	0.40	0.87	0.82	7.12	3.22	1.22	11.56	11.00	10.34	10.00	12848
0.62	0.89	0.57	0.80	2.88	2.87	7.64	3.61	0.43	11.68	11.00	11.25	10.00	12543
1.43	0.08	1.00	1.69	4.20	4.10	0.84	5.42	1.59	7.85	5.00	6.26	4.00	12851
1.37	0.94	0.08	0.84	3.23	3.29	7.80	2.28	0.68	10.76	11.00	10.08	10.00	12852
0.10	1.33	0.13	3.51	5.07	4.95	4.12	1.70	0.95	6.77	4.00	5.82	4.00	12576
0.48	3.36	5.21		9.05	9.06	2.23	1.59	0.64	4.46	3.00	3.82	3.00	12428
....	1.00	0.35	1.49	2.84	2.45	5.62	3.16	0.64	9.42	8.00	8.78	8.00	12544
0.13	1.16	0.20	2.78	4.27	4.11	3.94	1.49	1.00	6.43	4.00	5.43	4.00	12870
1.04	0.05	3.17		4.26	4.11	1.72	2.55	1.69	5.96	3.00	4.27	3.00	12429
0.59	0.88	0.59	0.81	2.87	2.87	7.40	3.76	0.45	11.61	11.00	11.16	10.00	12872
1.16	0.19	1.26	1.94	4.55	4.10	1.32	4.40	1.33	7.05	5.00	5.72	4.00	12873
0.13	1.05	0.42	0.83	2.43	2.46	6.68	4.03	0.60	11.31	11.00	10.71	10.00	12871

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	Pawtucket Rendering Co., Pawtucket, R. I.	
12894	Farm Favorite Brand 2½-10	Norwich
12893	Potato Fertilizer 4-10	Hebron
	Reliable Fertilizer Co., South Manchester, Conn.	
12896	Fish and Phosphate	Factory
	The Rogers and Hubbard Co., Portland, Conn.	
12874	All Soils-All Crops Phosphate	Hazardville
13327	Bone Base Oats and Top Dressing	Somerville
12879	Bone Base Oats and Top Dressing	Milford
13031[1]	Bone Base Soluble Corn and General Crops Manure	Gildersleeve
12875	Bone Base Soluble Corn and General Crops Manure	Branford
12877	R. & H. Bone Base Soluble Tobacco Manure	Gildersleeve
12578	R. & H. Complete Phosphate	Branford
12618	R. & H. Climax Tobacco Brand	Windsor
12617	R. & H. Potato Phosphate	Gildersleeve
	F. S. Royster Guano Co., Baltimore, Md.	
12577	Corn and Oats Ammoniated Phosphate	Branford
12777	Corn and Oats Ammoniated Phosphate	New Canaan
12776[1]	Landmark Ammoniated Phosphate	New Canaan
12925[1]	Penguin Ammoniated Phosphate	Glastonbury
13317	Penguin Ammoniated Phosphate	East Hartford
12579	Perfecto Tobacco Formula	Windsor
12627	Prime Fish Ammoniated Phosphate	New Canaan
12928	Steven's Formula	Glastonbury
	Sanderson Fertilizer and Chemical Co., New Haven, Conn.	
12931	High Grade Ammoniated Phosphate	Stratford
12932	Phosphate without Potash	Shelton
12631	Special without Potash	Wethersfield
12580	Tobacco Grower 1916	Silver Lane
12930	Top Dressing for Grass and Grain, 1916, without Potash	Mount Carmel
	M. L. Shoemaker and Co., Philadelphia, Pa.	
12935	Swift-Sure Phosphate for Tobacco and General Use	Glastonbury
	Springfield Rendering Co., Springfield, Mass.	
12936	Animal Fertilizer	Thompsonville

[1] See note, page 74.

WITHOUT POTASH—(*Continued*).

Nitrogen.						Phosphoric Acid.							
				Total.					Total.		So-called "Available."		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.74	0.09	0.46	0.95	2.24	2.06	6.21	3.96	0.86	11.03	11.00	10.17	10.00	12894
1.38	0.04	0.62	1.23	3.27	3.26	6.54	3.99	0.55	11.08	11.00	10.53	10.00	12893
....	0.22	0.39	1.18	1.79	1.64	8.24	3.07	1.56	12.87	10.50	11.31	10.00	12896
0.22	2.98	0.06	0.59	3.85	3.30	8.21	4.75	1.61	14.57	13.50	12.96	12.50	12874
3.92	0.10	2.07		6.09	6.00	0.07	5.47	8.89	14.43	12.00	5.54	6.00	13327
4.36	0.06	0.32	1.63	6.37	6.00	....	4.60	7.55	12.15	12.00	4.60	6.00	12879
0.33	0.89	0.45	0.73	2.40	2.50	2.49	7.09	3.48	13.06	12.00	9.58	10.00	13031
0.32	0.95	0.32	0.76	2.35	2.50	2.22	8.23	3.79	14.24	12.00	10.45	10.00	12875
0.12	1.56	1.21	2.13	5.02	5.00	1.15	9.53	2.70	13.38	13.00	10.68	10.00	12877
....	0.74	0.13	0.38	1.25	1.00	4.92	2.51	0.96	8.39	8.00	7.43	7.50	12578
0.05	1.94	0.57	1.77	4.33	4.12	0.07	2.94	1.66	4.67	4.00	3.01	3.00	12618
....	1.35	0.19	0.57	2.11	2.00	9.26	5.38	1.52	16.16	15.00	14.64	14.00	12617
....	0.28	0.14	0.45	0.87	0.82	4.42	3.00	1.02	8.44	8.50	7.42	8.00	12577
....	0.03	0.31	0.50	0.84	0.82	4.28	3.60	0.91	8.79	8.50	7.88	8.00	12777
....	1.32	0.27	1.14	2.73	3.29	7.13	2.82	0.64	10.59	10.50	9.95	10.00	12776
0.17	0.64	0.23	0.70	1.74	1.65	5.26	3.68	1.38	10.32	10.50	8.94	10.00	12925
0.11	0.85	0.25	0.62	1.83	1.65	6.71	3.69	0.91	11.31	10.50	10.40	10.00	13317
0.20	0.99	0.10	2.73	4.02	4.11	1.44	3.22	0.93	5.59	4.50	4.66	4.00	12579
....	0.90	0.24	0.46	1.60	1.65	5.21	3.11	0.90	9.22	8.50	8.32	8.00	12627
0.11	0.82	0.16	3.10	4.19	4.11	1.76	3.28	0.70	5.74	4.50	5.04	4.00	12928
0.22	1.50	0.45	1.30	3.47	3.29	6.35	3.67	1.83	11.85	11.00	10.02	10.00	12931
0.24	0.74	0.31	1.20	2.49	1.65	4.67	4.97	1.82	11.46	11.00	9.64	10.00	12932
0.36	1.12	0.37	1.01	2.86	2.47	6.91	3.57	1.84	12.32	11.00	10.48	10.00	12631
1.05	0.12	0.14	3.34	4.65	4.53	0.93	3.97	0.22	5.12	4.00	4.90	3.00	12580
1.24	1.04	0.74	1.88	4.90	4.11	4.23	4.24	2.62	11.09	9.00	8.47	8.00	12930
0.14	1.90	0.29	1.24	3.57	3.28	7.34	3.70	2.56	13.60	12.00	11.04	9.00	12935
0.11	0.81	1.09	0.76	2.77	2.46	7.03	4.24	0.78	12.05	11.00	11.27	10.00	12936

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	Virginia-Carolina Chemical Co., New York City.	
12960	Ammoniated Bone Phosphate for All Crops	Thomaston ....
12941	High Grade Corn and Vegetable Compound without Potash	North Haven ....
12582	Indian Brand for Tobacco (C. S. M. without Potash)	Glastonbury ....
12635	Tobacco and Onion Special	Glastonbury ....
	What Cheer Chemical Co., Pawtucket, R. I.	
12491	Ammonia 4 Acid Phosphate 10	Guilford ....
	Wilcox Fertilizer Co., Mystic, Conn.	
12899	Corn Special	Ellington ....
12898	Grain Fertilizer	Ellington ....
12584	Grass Fertilizer	Suffield ....
	Worcester Rendering Co., Auburn, Mass.	
12897	Royal Worcester Corn and Grain Fertilizer	Putnam ....
12641	Royal Worcester Potato and Vegetable Fertilizer..	Putnam ....
	Sampled by Purchasers:	
12556	Amer. Agri. Chem. Co.'s Ammoniated Fertz. AAA	*Deep River:*—Connectic ley Orchard Co. .....
12840	A. L. Koster's A. S. T. Special Corn Fertilizer ...	*Hartford:*—Fassler and man ....
12437	Olds and Whipple's Tobacco Special Fertilizer ...	*West Suffield:*—H. C.
13335	What Cheer Chemical Co.'s Special Tobacco	*Silver Lane:*—Thos. Mol
	Manufacturer's Sample:	
13238	Pawtucket Rendering Co.'s Animal Brand	Pawtucket, R. I. ....

WITHOUT POTASH—(*Concluded*).

Nitrogen.						Phosphoric Acid.							
				Total.					Total.		So-called "Available."		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Station No.
0.10	0.10	0.32	1.29	1.81	1.65	8.42	2.15	0.20	10.77	11.00	10.57	10.00	12960
0.21	0.97	0.14	1.24	2.56	2.47	8.62	2.36	0.23	11.21	11.00	10.98	10.00	12941
0.26	2.05	....	1.81	4.12	4.11	2.61	1.96	0.37	4.94	5.00	4.57	4.00	12582
....	1.50	0.50	1.41	3.41	3.29	6.27	1.66	0.33	8.26	9.00	7.93	8.00	12635
0.40	0.08	3.25		3.73	3.29	2.79	5.82	6.97	15.58	10.00	8.61	....	12491
0.56	0.87	0.46	1.57	3.46	3.30	7.67	3.04	0.83	11.54	11.00	10.71	10.00	12899
0.18	0.08	0.28	1.26	1.80	1.65	6.69	3.82	1.14	11.65	11.00	10.51	10.00	12898
1.11	0.87	0.46	1.62	4.06	4.12	6.21	2.78	1.28	10.27	9.00	8.99	8.00	12584
0.53	0.26	0.61	0.73	2.13	2.06	6.10	4.37	0.63	11.10	11.00	10.47	10.00	12897
0.56	0.98	1.01	0.83	3.38	3.23	6.72	4.48	0.75	11.95	11.00	11.20	10.00	12641
....	....	....	....	2.64	2.47	....	....	....	12.03	11.00	....	....	12556
....	....	....	....	4.17	4.10	7.18	1.26	0.54	8.98	....	8.44	8.00	12840
0.68	0.09	3.72		4.49	4.11	1.99	1.32	0.83	4.14	3.00	3.31	3.00	12437
....	....	....	....	4.75	3.00	2.21	3.03	0.88	6.12	....	5.24	....	13335
0.41	0.56	0.69	1.09	2.75	2.87	6.79	3.30	0.54	10.63	11.00	10.09	10.00	13238

NITROGENOUS SUPERPHOSPHATES CONTAINING POTASH.

In the table are given 107 analyses of brands belonging to this class. *(See page 92.)*

Composition and Cost of the Brands.

The amounts of potash guaranteed are naturally much smaller than before the war.

Of the samples drawn by the station agent

1 per cent. of potash was guaranteed in	72 samples.
2 " " " " " "	15 "
3 " " " " " "	9 "
4 " " " " " "	7 "
	103

Of nitrogen

.82 per cent. was guaranteed in	14 samples.
1.65 " " " "	24 "
2.47 " " " "	17 "
3.29 " " " "	18 "
4.11 " " " "	11 "
Over 4.11 per cent. in	18 "
Scattering	4 "
	106

To compare the relative economy of purchase of goods having these different guaranties of nitrogen we may make a "valuation" of the fertilizer elements guaranteed in each, allowing 45 cents per pound for nitrogen, 10 cents for "available" phosphoric acid and 30 cents for potash.

This has been done in the case of each brand, the valuation then compared with the average cost of each formula having the same nitrogen guaranty, the percentage difference between the quoted retail price calculated and the weighted average determined. The results are as follows:

Percentage Difference between Cost and Valuation.

	Percentage difference.	Average cost per ton.
10 brands carrying 0.82 per cent. nitrogen	52.2	$46.99
23 " " 1.65 " "	35.3	58.39
14 " " 2.47 " "	32.4	62.21
14 " " 3.29 " "	23.3	71.41
10 " " 4.11 " "	38.8	73.38

The "percentage difference" represents approximately the percentage amount, reckoned on the cost of the fertilizer ingredients themselves, which covers the costs, profits and losses of manufacture and selling.

The practical lesson taught by it is that it does not pay the buyer to get low grade goods if he wishes to buy a fertilizer for general use. The ton price is lower but the plant food in them costs more.

In cases where he wishes to use a relatively small amount of nitrogen with a larger quantity of phosphoric acid on a special crop, oats for example, he can generally save money by buying a small amount of high grade fertilizer and using with it a proper amount of acid phosphate, if he does not find it even more economical to buy all the chemicals unmixed and prepare the mixture himself. The economy of this practice must be largely determined in each case by costs of the chemicals and labor locally, and method of payment.

GUARANTIES.

Of the brands sampled by the station, 7 failed to meet the guaranty of nitrogen, 4 failed in available phosphoric acid and 9 in potash while two were deficient in both nitrogen and potash. In all cases, however, except those named below, the deficiency in one ingredient was fully covered in money value by the excess of another.

In five brands the money value of the deficiencies was more than one dollar per ton, valuing nitrogen at 45 cents, available phosphoric acid at 10 cents and potash at 30 cents per pound.

		Deficiency.
12781	Armour's Grain Grower 2-8-2	1.18
12709	Bowker's Complete Manure	1.97
12970	Bowker's Lawn and Garden Dressing	2.52
12831	Listers Special Tobacco Fertilizer 1916	1.18
12895	Pawtucket Rendering Co.'s 2-8-4 Fertilizer	2.10

QUALITY OF THE NITROGEN.

The solubility of the water-insoluble nitrogen as determined by the two methods in use (the neutral permanganate and alkaline permanganate methods) indicates that a portion of the organic nitrogen is of inferior agricultural value in the following brands:

12781 Armour's Grain Grower 2-8-2.
12915 Atlantic Packing Co.'s 2-8-4.
12536 Mapes's Potato Manure 1916.
12629 Royster's Fish and Potash Guano.
12924 Royster's Truckers' Delight.

Analysis requiring Special Notice.

12628. This sample, page 96, contained very much less nitrogen than was guaranteed in the brand which it was supposed to represent and also contained 2.52 per cent. of potash which was not guaranteed in that brand. It is quite certain that through some error the sample does not at all represent the brand the name of which it bore.

Borax in Fertilizers.

Borax is known to occur in the potash salts obtained from Searles Lake in California and it has been proved that even rather small amounts of borax in a fertilizer may be poisonous to crops.

The United States Department of Agriculture prescribes that no fertilizer shall contain more than two pounds of borax or its equivalent in the ton unless the actual amount of borax is plainly stated on the package or its tag.

The Maine Department of Agriculture through its Division of Inspection has ruled that any fertilizer containing an appreciable amount of borax or its compounds will be deemed to be adulterated.

In our opinion there is very little chance that any dangerous amount of borax will be found in fertilizers hereafter. Manufacturers are fully aware of the danger, which may be as disastrous to their business as to that of their customers.

HOME-MIXED NITROGENOUS SUPERPHOSPHATES.

13400. Made by H. D. Johnson, Highwood. 630 lbs. tankage, 400 lbs. Nebraska potash, 800 lbs. acid phosphate, 100 lbs. nitrate of soda.

12988. Made by Wesley N. Peck, Mt. Carmel. "Two parts acid phosphate, one part cotton seed meal."

12972. Mixed by Olds & Whipple, Hartford, to order of the American Sumatra Tobacco Co., Silver Lane Plantation.

12971. Mixed by the same firm for the same corporation, Windsor Locks Plantation.

ANALYSES.

	13400	12988	12972	12971
Nitrogen in nitrates	1.56	....	0.98	0.63
as ammonia	0.30	....	0.07	0.07
organic, water-soluble	} 2.34	....	0.08	0.47
active insoluble		....	2.22	1.58
inactive insoluble		....	2.02	1.73
total	4.20	2.03	5.37	4.48
Phosphoric acid, water-soluble	0.70	11.73	0.67	0.70
citrate-soluble	4.96	1.34	5.55	5.90
citrate-insoluble	2.64	0.20	0.23	0.26
total	8.30	13.27	6.45	6.86
Potash, calculated as muriate	1.36	....	....	0.76
as sulphate	3.21	....	....	2.90
total	4.57	0.66	....	3.66

VI. MISCELLANEOUS FERTILIZERS AND WASTE PRODUCTS.

TOBACCO STEMS AND STALKS.

Three samples were analyzed as follows:

13390. Green Tobacco Stalks. Sent by W. S. Pinney & Co., Suffield.

12495. Tobacco Stems. Sent by L. Wetstone, Ellington.

13525. Whipped Tobacco Stems. Sent by Windsor Paper and Waste Company, Windsor.

ANALYSES OF TOBACCO STEMS.

Station No.	13390	12495	13525
Nitrogen	0.23	2.13	1.03
Phosphoric acid	0.05	0.53	0.56
Potash (total)	0.41	6.09	4.84

The sample of green tobacco stalks, **13390**, consisted of 29 stalks from shade grown tobacco. Calculating 11,000 stalks to the acre, they would contain the following:

Nitrogen	60.5	pounds
Phosphoric acid	11.2	"
Potash	91.9	"

(*Continued on page 98.*)

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	American Agricultural Chemical Co., New York City.	
12643	Complete Potato Mixture	Southport
12652	Odorless Grass and Lawn Top Dressing Revised	Windsor
12510	Sure Growth Phosphate 1916	Glastonbury
12761	Bradley's Complete Manure for Potatoes and Vegetables	Groton
12760	Bradley's Corn Phosphate 1916	Willimantic
12607	Bradley's New Method Fertilizer 1916	Norwalk
12647	Bradley's Potato Manure 1916	Suffield
12762	Bradley's Potato Fertilizer 1919	Willimantic
12905	Bradley's B. D. Sea Fowl Guano	East River
12973	Bradley's Tobacco Manure Carbonate	East Hartford
12610	Bradley's Unicorn 1916	Bristol
12765	East India Corn King 1916	Southport
12764	East India Economizer Phosphate 1916	North Haven
12906	East India Potato and Garden Manure	Bloomfield
12608	Great Eastern General 1916	New Canaan
12907	Quinnipiac Ammoniated Dissolved Bone 1916	South Mancheste
12515	Quinnipiac Climax Phosphate 1916	Southport
12649	Quinnipiac Fish and Potash Mixture 1916	Windsor
12650	Quinnipiac Market Garden Manure 1916	Southport
12909	Wheeler's Cuban Tobacco Grower 1916	Granby
12651	Wheeler's Corn Fertilizer 1916	East Hampton
12908	Wheeler's Potato Manure 1916	East Hampton
12513	Williams and Clark's Matchless Fertilizer 1916	Waterbury
12913	Williams and Clark's Meadow Queen Fertilizer 1916	Milford
12514	Williams and Clark's Special Prolific Crop Producer	Waterbury
	Armour's Fertilizer Works, Chrome, N. J.	
12595	Armour's Crop Grower	New Canaan
12781	[1, 2]Armour's Grain Grower 2–8–2	New London
12518	Armour's 2–8–3	Windsor Locks
12958	Armour's Special Tobacco Grower No. 1	Suffield
12517	Armour's Wheat, Corn and Oats (Special) 1–7–1 Fertz.	New Haven
	Atlantic Packing Co., New Haven, Conn.	
12914	Atlantic 2–8–2	New Britain
12915	[2]Atlantic 2–8–4	New Britain
	Berkshire Fertilizer Co., Bridgeport, Conn.	
12782	Berkshire Complete Fertilizer	Ellington
12785	Berkshire Complete Tobacco	Scitico
	Bowker Fertilizer Co., New York City.	
12709	[1]Bowker's Complete	Milldale
12707	Bowker's Complete 3–8–3	Rockville

[1] See note, page 89. [2] See note, page 90.

WITH POTASH.

Nitrogen.					Phosphoric Acid.							Potash.			
			Total.					Total.		So-called "Available."					
In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As muriate.	Total.	Guaranteed.	Station No.
.32	0.21	1.07	3.38	3.29	9.15	1.65	0.46	11.26	11.00	10.80	10.00	3.28	3.28	3.00	12643
.15	0.16	0.85	3.62	3.91	3.94	2.02	0.50	6.46	6.00	5.96	5.00	0.68	1.37	1.00	12652
.11	0.16	1.07	2.81	2.47	3.27	5.79	1.71	10.77	10.00	9.06	9.00	0.74	1.17	1.00	12510
.52	0.06	1.02	3.42	3.29	6.78	3.01	1.16	10.95	10.00	9.79	9.00	0.72	1.13	1.00	12761
.63	0.09	0.95	1.75	1.65	6.76	3.31	1.15	11.22	11.00	10.07	10.00	0.70	1.12	1.00	12760
.03	0.31	0.54	0.88	0.82	6.37	2.55	0.84	9.76	9.00	8.92	8.00	0.84	1.08	1.00	12607
.73	0.22	0.90	2.59	2.47	7.68	2.27	1.01	10.96	10.00	9.95	9.00	0.64	1.12	1.00	12647
.59	0.05	0.94	1.74	1.65	6.85	3.59	1.15	11.59	11.00	10.44	10.00	0.72	1.10	1.00	12762
.08	0.43	0.51	1.02	0.82	7.68	2.96	0.87	11.51	11.00	10.64	10.00	1.00	1.00	1.00	12905
.05	0.92	2.63	4.60	4.53	0.40	4.48	0.12	5.00	4.00	4.88	3.00	0.52	*3.05	3.00	12973
.45	0.23	0.86	1.66	1.65	7.84	1.57	1.04	10.45	10.00	9.41	9.00	0.96	0.96	1.00	12610
.78	0.17	1.01	2.42	2.47	8.12	1.53	0.97	10.62	10.00	9.65	9.00	0.84	1.01	1.00	12765
.06	0.25	0.41	0.81	0.82	6.58	2.17	0.92	9.67	9.00	8.75	8.00	0.78	0.95	1.00	12764
.86	0.25	1.33	3.26	3.29	5.38	4.09	1.88	11.35	10.00	9.47	9.00	0.47	1.10	1.00	12906
.14	0.16	0.56	0.99	0.82	4.48	3.57	1.06	9.11	9.00	8.05	8.00	0.99	0.99	1.00	12608
.41	0.22	0.83	1.56	1.65	7.56	1.61	1.01	10.18	10.00	9.17	9.00	0.84	0.96	1.00	12907
.11	0.24	0.44	0.89	0.82	6.65	2.53	0.99	10.17	9.00	9.18	8.00	0.72	1.00	1.00	12515
.74	0.27	1.39	2.87	2.47	5.76	3.22	1.10	10.08	10.00	8.98	9.00	0.48	0.90	1.00	12649
.18	0.89	0.96	3.09	3.29	8.43	1.90	1.07	11.40	10.00	10.33	9.00	0.60	0.97	1.00	12650
.05	....	3.44	4.35	4.53	1.58	3.07	0.36	5.01	4.00	4.65	3.00	0.35	1.10	1.00	12909
.53	0.33	0.93	1.79	1.65	9.06	1.44	1.24	11.74	11.00	10.50	10.00	0.58	0.75	1.00	12651
.67	0.25	1.03	2.06	2.06	8.47	1.81	1.18	11.46	11.00	10.28	10.00	0.80	0.96	1.00	12908
.48	....	0.91	1.85	1.65	5.54	5.09	0.63	11.26	10.00	10.63	9.00	0.40	1.09	1.00	12513
.05	0.22	0.98	2.37	2.47	7.68	1.45	1.10	10.23	10.00	9.13	9.00	0.96	1.07	1.00	12913
.11	0.21	0.39	0.81	0.82	6.63	2.25	0.86	9.74	9.00	8.88	8.00	0.76	0.92	1.00	12514
.23	0.06	0.50	1.00	0.82	3.73	4.55	0.78	9.06	8.50	8.28	8.00	0.69	1.99	2.00	12595
.12	0.14	0.72	1.65	1.65	4.11	3.99	1.37	9.47	8.50	8.10	8.00	0.60	1.77	2.00	12781
.17	0.07	0.56	1.81	1.65	5.50	2.56	0.72	8.78	8.50	8.06	8.00	1.52	3.13	3.00	12518
.07	0.23	2.75	4.07	4.11	2.38	2.56	2.19	7.13	4.50	4.94	4.00	0.23	1.09	1.00	12958
.34	0.09	0.44	0.96	0.82	2.31	4.70	0.91	7.92	7.50	7.01	7.00	1.02	1.02	1.00	12517
.51	0.32	0.47	1.67	1.64	6.23	2.95	0.47	9.65	9.00	9.18	8.00	2.29	2.29	2.00	12914
.49	0.29	0.44	1.59	1.64	6.18	3.03	0.45	9.66	9.00	9.21	8.00	3.72	3.72	4.00	12915
.20	0.02	0.45	2.91	2.50	7.76	2.26	0.33	10.35	9.00	10.02	8.00	2.09	2.09	2.00	12782
.60	0.24	1.56	4.37	4.11	2.41	1.88	0.19	4.48	4.00	4.29	3.00	0.31	1.55	1.00	12785
.79	0.05	1.05	3.50	3.29	8.51	1.84	0.77	11.12	11.00	10.35	10.00	0.76	2.87	3.00	12709
.24	0.16	0.69	2.47	2.47	6.82	1.95	0.70	9.47	9.00	8.77	8.00	1.74	2.64	3.00	12707

otash as carbonate 2.05.

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	Bowker Fertilizer Co., New York City. (*Continued.*)	
12523	Bowker's Farm and Garden Phosphate 1916, Revised ...	New Haven ......
12708	Bowker's Hill and Drill Phosphate 1916	Hazardville ......
12970	[1]Bowker's Lawn and Garden Dressing 1918	New Haven ......
12706	Bowker's Potato Phosphate 1916	Norwich ....
12697	Bowker's Sure Crop Phosphate 1916	Waterbury ....
12599	Stockbridge General Crop Manure 1916	Milldale ....
	E. D. Chittenden Co., Bridgeport, Conn.	
12710	Complete Tobacco and Onion Grower 2% Potash	Suffield ....
12798	Connecticut Tobacco Grower with 2% Potash	West Suffield .....
12803	Tobacco Special with 2% Potash	Suffield ....
	Coe-Mortimer Co., New York City.	
12716	New Englander Special 1916	Brooklyn ....
12801	Red Brand Excelsior Guano 1916	Poquonock ....
	Essex Fertilizer Co., Boston, Mass.	
12858	Essex 2-8-2	South Manchester
	L. T. Frisbie Co., New Haven, Conn.	
12859	Frisbie's 1-8-3	Norwich ....
12861	Frisbie's 2-8-2	New London .....
12862	Frisbie's 2-8-4	Hartford ....
12527	Frisbie's 4-8-4	Branford ....
	International Agricultural Corporation, Buffalo, N. Y.	
12813	Buffalo Economy	West Cheshire ...
12815	Buffalo General Favorite	West Suffield ....
12817	Buffalo Potato and Corn	Moosup ....
12528	Buffalo Tip Top	Waterbury ....
	Lister's Agricultural Chemical Works, Newark, N. J.	
12827	Ammoniated Dissolved Superphosphate 1916	Andover ....
12828	Corn and Potato Fertilizer 1916	Danbury ....
12830	Perfect Potato Manure 1916	Rockville ....
12530	Potato and Corn No. 2 Fertilizer 1916	Yalesville ....
12831	[1]Special Tobacco Fertilizer 1916	Brookfield ....
12829	Standard Pure Superphosphate of Lime 1916	Burnside ....
12826	Success Fertilizer 1916	East Canaan .....
	Mapes Formula and Peruvian Guano Co., New York City.	
12536	[2]Corn Manure 1916 Brand	Suffield ....
12537	Potato Manure 1916 Brand	Meriden ....

[1] See note, page 89. [2] See note, page 90.

WITH POTASH—(*Continued*).

Nitrogen.				Phosphoric Acid.							Potash.			
Organic, water-soluble.	Organic, water-insoluble.	Total.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		As muriate.	Total.	Guaranteed.	Station No.
		Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.				
0.17	0.76	1.77	1.65	6.10	3.43	2.12	11.65	10.00	9.53	9.00	0.56	1.19	1.00	12523
0.70	0.52	2.59	2.47	8.02	2.18	0.81	11.01	10.00	10.20	9.00	0.39	1.00	1.00	12708
0.17	0.65	2.19	2.47	6.93	1.43	0.77	9.13	9.00	8.36	8.00	0.47	0.88	1.00	12970
0.18	0.64	1.86	1.65	5.69	5.22	1.69	12.60	11.00	10.91	10.00	0.66	1.11	1.00	12706
0.23	0.49	0.96	0.82	7.80	2.34	1.46	11.60	11.00	10.14	10.00	0.72	0.93	1.00	12697
0.04	0.96	3.30	3.29	7.87	1.42	0.92	10.21	10.00	9.29	9.00	0.08	0.98	1.00	12599
0.40	1.12	3.49	3.29	5.18	2.46	0.27	7.91	9.00	7.64	8.00	0.70	2.02	2.00	12710
0.33	2.05	5.24	4.94	2.52	2.30	0.77	5.59	5.00	4.82	4.00	0.40	2.09	2.00	12798
0.08	1.88	4.17	4.11	2.54	2.17	0.79	5.50	5.00	4.71	4.00	0.40	1.98	2.00	12803
0.06	0.50	0.94	0.82	5.09	2.88	0.78	8.75	9.00	7.97	8.00	0.74	1.08	1.00	12716
0.76	1.79	4.08	4.11	2.43	5.45	3.30	11.18	9.00	7.88	8.00	0.72	1.17	1.00	12801
0.48	0.64	1.73	1.64	6.25	2.22	0.75	9.22	9.00	8.47	8.00	2.10	2.10	2.00	12858
0.13	0.26	0.77	0.82	6.41	2.17	0.12	8.70	9.00	8.58	8.00	2.64	2.64	3.00	12859
0.34	0.52	1.81	1.64	4.39	4.46	0.60	9.45	9.00	8.85	8.00	0.84	1.84	2.00	12861
0.32	0.52	1.78	1.64	3.26	5.75	0.73	9.74	9.00	9.01	8.00	1.71	4.03	4.00	12862
0.82	1.12	3.61	3.29	3.72	5.03	1.25	10.00	9.00	8.75	8.00	1.75	3.94	4.00	12527
0.15	0.64	1.67	1.65	6.52	3.46	1.05	11.03	11.00	9.98	10.00	1.07	1.07	1.00	12813
0.12	0.41	0.86	0.80	4.98	3.68	1.54	10.20	9.00	8.66	8.00	1.11	1.11	1.00	12815
0.18	0.93	1.90	1.65	0.93	7.14	1.20	9.27	9.00	8.07	8.00	2.99	3.48	4.00	12817
0.17	0.37	0.86	0.80	4.96	3.63	1.20	9.79	9.00	8.59	8.00	1.90	1.90	2.00	12528
0.69	1.67	2.86	2.06	4.48	3.70	1.29	9.47	9.00	8.18	8.00	0.90	0.90	1.00	12827
1.26	0.77	2.13	2.06	6.14	3.08	1.35	10.57	9.00	9.22	8.00	0.39	0.96	1.00	12828
0.72	1.07	3.50	3.29	5.62	3.42	1.73	10.77	10.00	9.04	9.00	0.56	1.11	1.00	12830
0.87	0.92	2.22	2.06	5.02	4.17	2.41	11.60	11.00	9.19	10.00	0.56	0.99	1.00	12530
0.90	0.88	2.24	2.06	4.03	4.21	2.98	11.22	11.00	8.24	10.00	0.66	1.12	1.00	12831
0.72	1.68	3.06	2.47	5.74	3.31	1.85	10.90	10.00	9.05	9.00	0.96	1.04	1.00	12829
0.57	0.78	1.52	1.23	7.68	2.95	1.97	12.60	11.00	10.63	10.00	0.90	1.00	1.00	12826
0.13	1.16	2.87	2.47	0.78	7.20	4.26	12.24	10.00	7.98	8.00	0.56	1.01	1.00	12536
....	0.50	3.77	3.71	2.60	4.87	1.18	8.65	8.00	7.47	8.00	0.60	1.22	1.00	12537

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	Bowker Fertilizer Co., New York City. (*Continued.*)	
12523	Bowker's Farm and Garden Phosphate 1916, Revised ...	New Haven .....
12708	Bowker's Hill and Drill Phosphate 1916	Hazardville .....
12970	[1]Bowker's Lawn and Garden Dressing 1918	New Haven .....
12706	Bowker's Potato Phosphate 1916	Norwich ....
12697	Bowker's Sure Crop Phosphate 1916	Waterbury ......
12599	Stockbridge General Crop Manure 1916	Milldale ....
	E. D. Chittenden Co., Bridgeport, Conn.	
12710	Complete Tobacco and Onion Grower 2% Potash	Suffield ....
12798	Connecticut Tobacco Grower with 2% Potash	West Suffield ....
12803	Tobacco Special with 2% Potash	Suffield ....
	Coe-Mortimer Co., New York City.	
12716	New Englander Special 1916	Brooklyn ....
12801	Red Brand Excelsior Guano 1916	Poquonock ......
	Essex Fertilizer Co., Boston, Mass.	
12858	Essex 2-8-2	South Manchester
	L. T. Frisbie Co., New Haven, Conn.	
12859	Frisbie's 1-8-3	Norwich ....
12861	Frisbie's 2-8-2	New London ....
12862	Frisbie's 2-8-4	Hartford ....
12527	Frisbie's 4-8-4	Branford ....
	International Agricultural Corporation, Buffalo, N. Y.	
12813	Buffalo Economy	West Cheshire ..
12815	Buffalo General Favorite	West Suffield ...
12817	Buffalo Potato and Corn	Moosup ....
12528	Buffalo Tip Top	Waterbury ......
	Lister's Agricultural Chemical Works, Newark, N. J.	
12827	Ammoniated Dissolved Superphosphate 1916	Andover ....
12828	Corn and Potato Fertilizer 1916	Danbury ....
12830	Perfect Potato Manure 1916	Rockville ....
12530	Potato and Corn No. 2 Fertilizer 1916	Yalesville ....
12831	[1]Special Tobacco Fertilizer 1916	Brookfield ......
12829	Standard Pure Superphosphate of Lime 1916	Burnside ....
12826	Success Fertilizer 1916	East Canaan ....
	Mapes Formula and Peruvian Guano Co., New York City.	
12536	[2]Corn Manure 1916 Brand	Suffield ....
12537	Potato Manure 1916 Brand	Meriden ....

[1] See note, page 89. [2] See note, page 90.

WITH POTASH—(*Continued*).

Nitrogen.					Phosphoric Acid.							Potash.			
			Total.					Total.		So-called "Available."					
In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As muriate.	Total.	Guaranteed.	Station No.
06	0.17	0.76	1.77	1.65	6.10	3.43	2.12	11.65	10.00	9.53	9.00	0.56	1.19	1.00	12523
29	0.70	0.52	2.59	2.47	8.02	2.18	0.81	11.01	10.00	10.20	9.00	0.39	1.00	1.00	12708
98	0.17	0.65	2.19	2.47	6.93	1.43	0.77	9.13	9.00	8.36	8.00	0.47	0.88	1.00	12970
45	0.18	0.64	1.86	1.65	5.69	5.22	1.69	12.60	11.00	10.91	10.00	0.66	1.11	1.00	12706
11	0.23	0.49	0.96	0.82	7.80	2.34	1.46	11.60	11.00	10.14	10.00	0.72	0.93	1.00	12697
31	0.04	0.96	3.30	3.29	7.87	1.42	0.92	10.21	10.00	9.29	9.00	0.08	0.98	1.00	12599
85	0.40	1.12	3.49	3.29	5.18	2.46	0.27	7.91	9.00	7.64	8.00	0.70	2.02	2.00	12710
61	0.33	2.05	5.24	4.94	2.52	2.30	0.77	5.59	5.00	4.82	4.00	0.40	2.09	2.00	12798
96	0.08	1.88	4.17	4.11	2.54	2.17	0.79	5.50	5.00	4.71	4.00	0.40	1.98	2.00	12803
38	0.06	0.50	0.94	0.82	5.09	2.88	0.78	8.75	9.00	7.97	8.00	0.74	1.08	1.00	12716
10	0.76	1.79	4.08	4.11	2.43	5.45	3.30	11.18	9.00	7.88	8.00	0.72	1.17	1.00	12801
51	0.48	0.64	1.73	1.64	6.25	2.22	0.75	9.22	9.00	8.47	8.00	2.10	2.10	2.00	12858
19	0.13	0.26	0.77	0.82	6.41	2.17	0.12	8.70	9.00	8.58	8.00	2.64	2.64	3.00	12859
86	0.34	0.52	1.81	1.64	4.39	4.46	0.60	9.45	9.00	8.85	8.00	0.84	1.84	2.00	12861
80	0.32	0.52	1.78	1.64	3.26	5.75	0.73	9.74	9.00	9.01	8.00	1.71	4.03	4.00	12862
00	0.82	1.12	3.61	3.29	3.72	5.03	1.25	10.00	9.00	8.75	8.00	1.75	3.94	4.00	12527
32	0.15	0.64	1.67	1.65	6.52	3.46	1.05	11.03	11.00	9.98	10.00	1.07	1.07	1.00	12813
24	0.12	0.41	0.86	0.80	4.98	3.68	1.54	10.20	9.00	8.66	8.00	1.11	1.11	1.00	12815
59	0.18	0.93	1.90	1.65	0.93	7.14	1.20	9.27	9.00	8.07	8.00	2.99	3.48	4.00	12817
23	0.17	0.37	0.86	0.80	4.96	3.63	1.20	9.79	9.00	8.59	8.00	1.90	1.90	2.00	12528
33	0.69	1.67	2.86	2.06	4.48	3.70	1.29	9.47	9.00	8.18	8.00	0.90	0.90	1.00	12827
10	1.26	0.77	2.13	2.06	6.14	3.08	1.35	10.57	9.00	9.22	8.00	0.39	0.96	1.00	12828
57	0.72	1.07	3.50	3.29	5.62	3.42	1.73	10.77	10.00	9.04	9.00	0.56	1.11	1.00	12830
24	0.87	0.92	2.22	2.06	5.02	4.17	2.41	11.60	11.00	9.19	10.00	0.56	0.99	1.00	12530
40	0.90	0.88	2.24	2.06	4.03	4.21	2.98	11.22	11.00	8.24	10.00	0.66	1.12	1.00	12831
33	0.72	1.68	3.06	2.47	5.74	3.31	1.85	10.90	10.00	9.05	9.00	0.96	1.04	1.00	12829
17	0.57	0.78	1.52	1.23	7.68	2.95	1.97	12.60	11.00	10.63	10.00	0.90	1.00	1.00	12826
05	0.13	1.16	2.87	2.47	0.78	7.20	4.26	12.24	10.00	7.98	8.00	0.56	1.01	1.00	12536
05	....	0.50	3.77	3.71	2.60	4.87	1.18	8.65	8.00	7.47	8.00	0.60	1.22	1.00	12537

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	Mapes Formula and Peruvian Guano Co., New York City. (*Continued.*)	
12836	C. S. Tobacco Manure	Burnside
12538	Tobacco Starter Improved	Hartford
	National Fertilizer Co., New York City.	
12868	Complete Root and Grain Fertilizer 1916	Silver Lane
12867	Eureka Potato Fertilizer 1916	Guilford
12866	Market Garden Revised Fertilizer	Willimantic
12845	Universal Grain and Potato Fertilizer	Willimantic
12846	Universal Phosphate 1916	Wallingford
12847	XXX Fish and Potash 1916	South Manchester
	Olds and Whipple, Hartford, Conn.	
12869	Complete Corn, Potato and Onion Fertilizer	Factory
12575	Complete Tobacco Fertilizer	Factory
	Pawtucket Rendering Co., Pawtucket, R. I.	
12895	[1]2-8-4 Fertilizer	Gilead
	Rogers and Hubbard Co., Portland, Conn.	
13318	Hubbard's Bone Base Fertilizer for Seeding Down	Factory
12876	Hubbard's Bone Base Soluble Potato Manure	Milford
12878	R. and H. Tobacco Grower (Vegetable Formula)	Gildersleeve
13366	R. and H. Tobacco Grower (Vegetable Formula)	Windsor Locks
	F. S. Royster Guano Co., Baltimore, Md.	
12927	Arrow Head Tobacco Formula	Glastonbury
12630	Dreadnaught Guano	Plainville
12629	[2]Fish and Potash Guano	Branford
12628	[2]	Madison
12926	Pipe of Peace Tobacco Formula	Norwich
12924	[2]Trucker's Delight Guano	East Granby
	Sanderson Fertilizer and Chemical Co., New Haven, Conn.	
12634	Atlantic Coast Bone, Fish and Potash 1916	Branford
12632	Corn Superphosphate 1916	Branford
12581	Formula A 1916	Guilford
12929	Formula B 1916	Windsor Locks
12633	Potato Manure 1916	East Hampton
12933	Kelsey's Bone, Fish and Potash 1916	Branford

[1] See note, page 89. [2] See note, page 90.

WITH POTASH—(*Continued*).

Nitrogen.				Phosphoric Acid.							Potash.			
Organic, water-soluble.	Organic, water-insoluble.	Total.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		As muriate.	Total.	Guaranteed.	Station No.
		Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.				
0.15	2.54	4.57	4.12	0.35	4.08	0.57	5.00	4.00	4.43	4.00	0.70	1.26	1.00	12836
0.36	1.03	4.84	4.12	1.07	5.14	2.94	9.15	8.00	6.21	6.00	1.08	1.40	1.00	12538
0.24	0.78	3.40	3.29	7.37	2.02	1.15	10.54	10.00	9.39	9.00	0.40	1.06	1.00	12868
....	0.93	2.40	2.47	7.37	2.60	0.52	10.49	10.00	9.97	9.00	0.52	0.88	1.00	12867
0.10	0.68	2.57	2.47	4.85	4.10	0.70	9.65	9.00	8.95	8.00	2.07	2.88	3.00	12866
0.09	0.48	0.90	0.82	5.38	3.01	0.64	9.03	9.00	8.39	8.00	0.35	1.03	1.00	12845
0.19	0.43	0.81	0.82	7.30	2.89	1.22	11.41	11.00	10.19	10.00	0.12	0.88	1.00	12846
0.23	1.07	2.37	2.06	5.81	4.87	1.52	12.20	11.00	10.68	10.00	0.36	0.93	1.00	12847
0.11	2.28	3.99	3.30	1.22	5.78	1.07	8.07	6.00	7.00	6.00	0.80	1.24	1.00	12869
0.33	3.38	4.38	4.11	1.07	3.02	0.29	4.38	3.00	4.09	3.00	0.32	1.47	1.00	12575
0.33	0.31	1.39	1.75	5.96	3.63	0.36	9.95	9.00	9.59	8.00	3.64	3.64	4.00	12895
0.50	1.77	2.83	2.47	0.43	6.75	11.48	18.66	15.00	7.18	6.00	2.22	4.15	4.00	13318
0.45	1.39	4.24	4.25	1.25	8.90	2.60	12.75	13.00	10.15	10.00	1.07	1.98	2.00	12876
0.28	4.10	5.21	5.00	0.19	5.30	2.32	7.81	5.00	5.49	4.00	0.31	1.15	1.00	12878
0.11	3.73	5.06	5.00	0.13	4.97	2.17	7.27	5.00	5.10	4.00	0.35	1.13	1.00	13366
0.16	3.06	4.30	4.11	1.83	2.73	0.56	5.12	4.50	4.56	4.00	0.17	1.88	2.00	12927
0.34	0.70	1.88	1.65	4.47	3.74	1.05	9.26	8.50	8.21	8.00	0.23	2.07	2.00	12630
0.23	0.44	1.65	1.65	5.57	2.57	0.78	8.92	8.50	8.14	8.00	0.23	0.93	1.00	12629
0.28	0.83	2.07	....	4.75	5.60	0.79	11.14	....	10.35	....	....	2.59	....	12628
0.24	2.69	3.86	4.11	1.24	2.47	0.65	4.36	3.50	3.71	3.00	0.11	1.23	1.00	12926
0.50	0.94	3.21	3.29	1.97	6.22	1.25	9.44	8.50	8.19	8.00	1.04	3.96	4.00	12924
0.25	1.03	1.88	1.65	2.27	6.81	2.69	11.77	10.00	9.08	9.00	0.76	1.09	1.00	12634
0.31	1.02	2.01	1.65	4.44	5.70	2.92	13.06	11.00	10.14	10.00	0.56	1.09	1.00	12632
0.14	1.33	3.59	3.29	6.89	3.01	1.10	11.00	10.00	9.90	9.00	0.45	1.31	1.00	12581
0.22	1.32	3.05	3.28	5.42	4.39	2.43	12.24	10.00	9.81	9.00	0.44	1.00	1.00	12929
0.11	0.87	2.14	2.06	1.97	6.02	1.71	9.70	9.00	7.99	8.00	0.64	0.98	1.00	12633
0.16	1.08	2.48	2.47	3.71	5.30	2.84	11.85	10.00	9.01	9.00	0.58	1.02	1.00	12933

NITROGENOUS SUPERPHOSPHATES

Station No.	Manufacturer and Brand.	Place of Sampling.
	Sampled by Station:	
	Virginia-Carolina Chemical Co., New York City.	
12937	Indian Brand for Tobacco No. 1	Tariffville
12938	Indian Brand for Tobacco No. 2	Granby
12939	National Corn, Grain and Grass Top Dressing	Hartford
12940	Owl Brand Potato and Truck Fertilizer with 1% Potash	Hartford
12583	Star Brand Potato and Vegetable Compound	North Haven
12636	XXXX Fish and Potash Mixture	North Haven
	Wilcox Fertilizer Co., Mystic, Conn.	
12585	Fish and Potash	Branford
12950	4-8-4 Fertilizer	Factory
12944	High Grade Fish and Potash	Factory
12619	Potato Fertilizer	Meriden
12637	Potato, Onion and Vegetable Phosphate	Mystic
12900	Tobacco Special	Ellington
	S. D. Woodruff and Sons, Orange, Conn.	
12642	Home Mixture	Factory
	Sampled by Purchaser:	
12839	American Agricultural Chemical Co.'s Bradley Fertilizer	Hartford
12918	Olds and Whipple's Complete Tobacco Fertilizer	Hartford

If a cutter were available it would pay to cut these stalks and spread evenly and plow under in the fall unless a cover crop had been sown.

LIME-FERTILE AND NITRO-FERTILE.

These are two fertilizers made by the Fertile Chemical Co., Cleveland, Ohio, and entered for sale in the state. Their analyses follow:

12564. Nitro-Fertile. Sampled from stock of Church and Morse, Meriden. Price 60 cents per bottle.

12566. Lime-Fertile. Sampled from stock of A. R. Brewer & Co., Hartford. Price 35 cents for a 5 lb. package.

WITH POTASH—(*Concluded*).

Nitrogen.				Phosphoric Acid.							Potash.			
		Total.					Total.		So-called "Available."					
Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As muriate.	Total.	Guaranteed.	Station No.
0.16	1.59	4.02	4.11	2.28	2.30	0.67	5.25	5.00	4.58	4.00	0.45	1.94	2.00	12937
0.22	1.62	4.12	4.11	2.84	1.95	0.38	5.17	5.00	4.79	4.00	0.20	1.07	1.00	12938
0.35	1.00	2.99	3.29	7.32	1.49	0.78	9.59	9.00	8.81	8.00	0.35	1.10	1.00	12939
0.08	0.58	1.69	1.65	5.44	3.67	0.95	10.06	9.00	9.11	8.00	0.31	1.01	1.00	12940
0.30	0.98	3.80	3.29	5.37	3.35	0.27	8.99	9.00	8.72	8.00	0.80	2.90	3.00	12583
0.29	0.58	2.07	1.65	4.40	2.83	0.23	7.46	9.00	7.23	8.00	0.20	0.81	1.00	12636
0.45	1.81	2.67	2.46	6.26	2.32	0.59	9.17	9.00	8.58	8.00	1.41	1.41	1.00	12585
0.39	1.38	3.43	3.30	5.28	3.28	2.98	11.54	9.00	8.56	8.00	3.38	4.10	4.00	12950
0.49	2.12	3.04	2.46	2.01	6.37	2.78	11.16	9.00	8.38	8.00	0.31	3.36	3.00	12944
0.10	0.79	1.77	1.65	6.12	2.94	0.79	9.85	9.00	9.06	8.00	2.23	2.23	2.00	12619
0.27	1.52	3.26	3.30	7.31	2.21	0.64	10.16	10.00	9.52	9.00	1.28	1.28	1.00	12637
....	3.00	4.15	4.11	1.71	3.85	4.61	10.17	5.00	5.56	4.00	1.00	1.46	1.00	12900
0.16	1.71	3.07	3.29	6.66	5.03	2.58	14.27	....	11.69	8.00	....	0.16	1.00	12642
....	....	4.61	4.53	0.43	4.38	0.10	4.91	4.00	4.81	3.00	0.52	*3.13	3.00	12839
....	....	4.20	4.11	0.49	3.42	0.31	4.22	3.00	3.91	3.00	0.48	1.54	1.00	12918

as carbonate.

ANALYSES.

	12564 Found	12564 Guaranteed	12566 Found	12566 Guaranteed
Nitrogen as nitrates	2.52	...	....	...
total	2.52	2.0	....	...
Phosphoric acid	3.70	3.0	3.03	3.0
Potash calculated as sulphate	1.47	...	....	...
as muriate	3.27	...	....	...
total	4.74	3.0	....	...

SHEEP MANURE.

Ten samples were analyzed as follows:

12758. Pulverized Sheep Manure. Sold by American Agricultural Chemical Co., New York City. Stock of Geo. E. Ackley Co., New Milford.

12521. Liberty Brand Sheep Manure. Sold by Apothecaries Hall Co., Waterbury. Stock of Chas. A. Templeton, Waterbury.

12596. Sheep Manure. Sold by Armour Fertilizer Wks., Chrome, N. J. Stock of F. S. Bidwell & Co., Windsor Locks.

12809. Ground Sheep Manure. Sold by Berkshire Fertilizer Co., Bridgeport. Stock of C. Buckingham, Southport.

12805. Magic Brand Pulverized Sheep Manure. Sold by Chicago Feed and Fertilizer Co., Chicago, Ill. Stock of The F. S. Platt Co., New Haven.

12952. Sheep Manure. Sold by Mid-West Potash and Fertilizer Co., Omaha, Neb. Stock of S. D. Woodruff & Sons, Orange.

12724. "Sheeps Head" Pulverized Sheep Manure. Sold by Natural Guano Co., Aurora, Ill. Stock of Rackliffe Bros. Co., New Britain.

12727. Wizard Brand. Sold by Pulverized Manure Co., Chicago, Ill. Stock of Lightbourn & Pond Co., New Haven.

12490. Sheep Manure. Sold by Natural Guano Co., Aurora, Ill. Sampled and sent by Cadwell & Jones, Hartford.

12674. "Magic" Sheep Manure. Sold by Chicago Feed and Fertilizer Co., Chicago, Ill. Sampled and sent by F. F. Hitchcock, Woodbury.

ANALYSES OF SHEEP MANURE.

Station No.	12758	12521	12596	12809	12805	12952	12724	12727	12490	1
Per cent. of										
Nitrogen as nitrates	....	....	0.38	....	....	....	0.16	0.09	....	
" " ammonia	0.30	0.12	0.14	0.37	0.10	....	0.29	0.19	0.18	
" organic	1.72	1.70	1.48	2.08	1.34	....	1.93	1.83	2.34	
" total found	2.02	1.82	2.00	2.45	1.44	1.26	2.38	2.11	2.52	
" " guaranteed	2.06	2.00	1.65	1.70	1.85	....	2.25	1.80	....	
Phosphoric acid, water-soluble	0.35	0.36	0.15	0.12	0.29	0.28	1.14	0.58	1.09	
Phosphoric acid, citrate-soluble	1.34	0.99	1.48	0.44	0.84	1.01	0.98	0.96	0.72	
Phosphoric acid, citrate-insoluble	0.46	0.22	0.14	0.12	0.15	0.12	0.13	0.12	0.10	
Phosphoric acid, total found	2.15	1.57	1.77	0.68	1.28	1.41	2.25	1.66	1.91	
Phosphoric acid, total guaranteed	1.25	1.50	1.00	1.00	1.50	....	1.00	1.00	....	
Water-soluble potash found	2.71	2.13	4.41	1.91	2.46	1.46	2.48	2.34	2.85	
Water-soluble potash guaranteed	1.00	2.00	2.50	1.00	1.25	....	1.50	1.00	....	
Chlorine	1.10	0.33	1.34	0.17	0.72	0.23	0.56	0.83	....	
Cost per ton	$46.00	42.00	46.00	44.00	50.00	....	55.00	55.00	46.00	

The average composition and cost per ton of sheep manure as determined from these analyses are as follows:

Nitrogen	1.99
Phosphoric acid	1.63
Potash	2.55
Cost per ton	$48.00

The agricultural value of fresh manure is largely in the organic matter which it contains in forms that decay quickly and in its bacterial life. The use of dry sheep manure is chiefly in greenhouse work and on lawns.

"WOOD ASHES."

In the table are given 21 analyses of material sold under this name. Six of the samples are certainly not fairly called wood ashes. **12655** has the composition of lime-kiln ashes and **12147** does not contain even as much potash as ordinary lime-kiln ashes.

During the war, wood ashes have been sold on the "unit" basis, a unit being one per cent. or 20 pounds. The price this year has ranged from $6 to $6.50 per unit or from 30 to 32½ cents per pound of potash without regard to the lime or phosphoric acid contained in the ashes.

The higher per cent. of phosphoric acid, 6.40, contained in the ashes sold by E. E. Dickinson & Co., **12418**, is explained by the fact that the ashes came from witch hazel brush. The fine twigs carry considerably more phosphoric acid than does mature wood. With reference to **12102** and **12159** Mr. Joynt states that none of the other cars shipped at the same time from the same storehouse showed less than 5.6 per cent. of potash. Sample **12102** was drawn by the director personally with the greatest care to take portions from all accessible parts of the car and the analysis was most carefully checked.

LIME AND LIME-KILN ASHES.

13543. Ground Oyster Shells from S. P. Woodward, Bethany.

12919. Lime ashes. Sent by L. A. Bevan, Danbury. Cost $15 per ton.

12855. Lime-kiln ashes made by New England Lime Co., Boardman. Sent by Howard I. Hine, New Milford. Cost $12 per ton.

LIBRARY

ANALYSES OF WOOD ASHES.

Station No.	Car No. and Dealer or Purchaser.	Insoluble in acid (sand).	Water-soluble potash.	Lime.	Phosphoric acid.
12792	C. M. Beach Co., New Milford	4.02	0.84	36.19	0.90
12791	C. M. Beach Co., New Milford	2.35	8.61	32.59	1.50
12342	Car R. I. 56111. Frank Brockett, Suffield	17.30	5.00	30.64	1.94
12748	Conn. Sumatra Tobacco Co., Buckland, No. 1	15.90	1.73	27.62	1.13
12749	Conn. Sumatra Tobacco Co., Buckland, No. 2	14.92	1.77	25.72	1.11
12750	Conn. Sumatra Tobacco Co., Buckland, No. 3	15.22	1.94	26.70	1.11
12418	E. E. Dickinson & Co., Essex	5.45	5.45	46.55	6.40
12620	Car C. P. 149238. Edward Eggert, Hartford	14.02	6.10	33.88	2.30
12147	A. N. Farnham, Westville	74.42	0.04	....	....
12102	Car 197813. John Joynt, Lucknow, Ont. Henry Fuller, Suffield	10.86	4.47	31.34	1.85
12191	John Joynt, Lucknow, Ont. A. R. Ford Co., Suffield	19.93	4.85	29.30	1.91
12159	John Joynt, Lucknow, Ont. Harvey Fuller, Suffield. B. & O. 183128	13.58	3.94	29.84	3.00
12500	John Joynt, Lucknow, Ont. F. L. Harvey, Windsor Locks	11.65	6.94	37.15	2.14
12621	John Joynt, Caribou, Me. Griffin Tobacco Co., Inc. N. Bloomfield. Car 6976	13.23	5.92	33.96	2.15
12622	John Joynt, Caribou, Me. Griffin Tobacco Co., Inc. N. Bloomfield. Car 1546	10.60	5.62	35.48	2.16
12623	John Joynt, Caribou, Me. Griffin Tobacco Co., Inc. N. Bloomfield. Car 14804	15.08	6.30	32.59	2.43
12655	Clarence E. Lee, New Milford	4.73	0.86	38.53	0.81
11549	W. L. Mitchell, New Haven. F. J. Beach, Woodmont	11.53	2.92	28.70	1.12
12432	W. L. Mitchell, New Haven. J. E. Shepard, South Windsor	17.70	3.08	27.63	1.19
12184	Olds & Whipple, Hartford. Car 3719	9.42	6.27	34.76	2.10
12640	Wm. L. Peck, New York. C. E. Daniell, Woodbury	39.20	3.47	23.39	1.41

* $6.50 per unit of water-soluble potash. † $6.00 per unit of water-soluble potash. ‡ f. o. b. Brightwoo

ANALYSES OF LIME AND LIME-KILN ASHES.

Station No.	13543	12919	12855
Water-soluble potash	none	3.84	1.95
Lime	40.94	36.86	36.70
Magnesia	....	9.40	14.59

12919 supplies water-soluble potash at 19 cents per pound, relatively a very cheap price. The cost in **12855** is about 30 cents.

SOILS.

A very large number have been tested for acidity but the results are not of any general interest or value.

PEAT AND MUCK.

12164 was sent by M. F. McLaughlin, Bridgeport, **12165** by L. Peterson, East Hartford, and **12146** by T. H. Thorne, superintendent, New Canaan.

These require no further notice.

The samples represented by the first three analyses in the table were sent by Henry H. Witzke, Fairfield. They are from a maple swamp in which the peat is at least 20 feet deep. The three samples were taken at depths of 6, 12 and 18 feet respectively. They consist of peat with very little mixture of soil.

12165 was sent with the question whether it would be good on sandy land. This sample, too, is a rich peat. If used in large amount and well distributed through a sandy soil it would undoubtedly improve its water-holding power though of very little value as a fertilizer. The nitrogen of peat is very inert being the part which has resisted decay and solution.

Peat which has been more than half dried makes one of the best absorbents in the manure trenches, tends to prevent loss of ammonia and improves the manure.

13359 is stated to be everglade soil taken near the southern end of Lake Okeechobee in Florida on which sugar cane and vegetables can be grown very successfully without the use of any fertilizer.

This consists of about equal parts of mineral matter or soil and of peat. It has a higher per cent. of nitrogen than any other of the samples; probably it is never subject to drought and may grow crops for a time without fertilizers or manure.

	12464	12465	12466	12165	12164	13359	12146
As received:							
Water	90.86	86.29	56.28	12.10	17.80	15.33	67.18
Organic and volatile	8.62	12.82	39.63	76.32	54.37	42.49	11.95
Ash	0.52	0.89	4.09	11.68	27.83	42.18	20.87
Nitrogen	0.16	0.16	0.11	1.57	1.56	2.00	0.34
Phosphoric acid	....	....	....	....	....	0.32	....
Potash	....	....	....	....	....	0.23	....
Calculated water-free:							
Organic and volatile	94.26	93.49	90.62	86.73	66.15	50.18	36.40
Ash	5.74	6.51	9.38	13.27	33.85	49.82	63.60
Nitrogen	1.77	1.18	0.25	1.78	1.89	2.36	1.05
Phosphoric acid	....	....	....	....	....	0.38	....
Potash	....	....	....	....	....	0.27	....

VARIOUS MARINE FERTILIZERS.

12471, Dried Sea Kelp and **12657**, Dried Ground Mussel bed, both prepared by E. J. Eaton, New London.

13474, Cove Mud and **13475**, Channel Weed, sent by E. E. Knapp, Essex.

ANALYSES.

	12471	12657	13474	13475
Water	....	....	2.89	5.55
Organic and volatile	....	....	7.57	26.02
Mineral matter	....	....	89.54	68.43
Nitrogen	1.23	1.33	0.38	1.30
Phosphoric acid	0.35	0.32	0.26	0.49
Potash	2.54	0.14	0.57	0.77

The plant food in the dried kelp and dried mussel bed is probably quite readily available to crops. Whether either can profitably be used depends altogether on the cost of getting out the material and transporting it. Kelp was formerly used with profit on some seashore farms where it was abundant and the haul to the land was short. The best results were got where it was hauled at once to the land and immediately plowed in. The same probably applies to channel weed **13475.**

With regard to **13474** Mr. Knapp says there is a limitless quantity, not over 1000 feet from porous land needing amendment.

It is a fine material not unlike ordinary soil, as far as the analysis indicates, having in the water-free material only 7.8 per cent. of organic matter.

The percentages of nitrogen and phosphoric acid are also small. Marine mud hauled out in the fall and allowed to stand over winter has been found to have considerable value as an amendment and fertilizer. It cannot be recommended as certainly profitable in any case but is worth a trial on a small scale.

VARIOUS NITROGENOUS WASTE PRODUCTS.

11818. Sent by B. W. Ellis, Co. Agent, Rockville. This is material which has been used as a bird food and as such sold for about $90 a ton. It contained 6.98 per cent. of nitrogen and 3.84 of phosphoric acid. Probably both are in available form and if so the price would not be more nearly prohibitive of its use as a fertilizer than is the present price of cotton seed meal.

12461. Sent by H. Hawkes, Sound Beach, is stated to be from a dressed beef company and contained 7.16 per cent. of nitrogen.

12773, Skin Choppings and Hair, contained 9.40 per cent. nitrogen. **12774,** Dyed Waste Fur, contained 11.68 per cent. Both samples were sent by G. M. Reynolds, Glennville. Neither of them is of much agricultural value in their present shape.

12961. Shavings from Lace Leather, sent by Jewell Belting Co., Hartford, contained 11.85 per cent. nitrogen of little agricultural value.

11724 and **11725.** Cotton by-products from American Sumatra Tobacco Co., East Hartford.

13370. Fertilizer from Willy Waldag, Suffield. **12704** and **12705** from Hyman Botwinik, Colchester, stated to be made by Shay of New London. **13473,** sent by B. W. Ellis, Co. Agent, Putnam, stated to be Berkshire Fertilizer. **12797,** sent by W. A. Bertini, Granby, marked "Hayti," bought of Berkshire Fertilizer Co. **12882,** a fertilizer sold by the Quality Seed Store, Stamford. Sent by A. F. Aulick, Stamford. **13253,** fertilizer from J. L. Crowley, Westerly, R. I.

Analyses.

Per cent. of	11724	11725	13370	12704	12705	13473	12797	12882	13253
Nitrogen	1.78	1.42	0.78	4.76	3.18	3.51	3.91	1.25	4.95
Phosphoric acid	0.82	0.80	0.87	14.43	11.64	...	...	12.82	...
Potash	1.55	1.19	1.81	0.34	0.42	...	...	1.43	...

Two samples marked Sewage Sludge were examined.

12493 received from Andrew Ure, Highwood, contained nitrogen 0.28, phosphoric acid 0.22 and sand and soil 78.20 per cent. **13360,** sent by Frank Bachmann, New Haven, stated to be made by the Independent Dye Co., Long Island, contained 16.35 per cent. of phosphoric acid.

13472. Stated to be Wilcox Fertilizer Co.'s 4-8-4 Potato Fertilizer. Sent by Wm. Inderelst, Mystic, with request to test for borax. It was found to contain about 0.29 per cent. of boric acid.

VITAMITE.

13372. Sold by John R. Keefe, Newark, N. J. This claims to be "a new bacterial culture, unlike others on the market." This station is not equipped to make bacterial examinations. Of

plant food Vitamite contains 1.42 per cent. nitrogen, 0.90 of phosphoric acid and 1.26 of potash. Sand and mineral matter amounted to 65.30 per cent.

A sample of "Slag," sent by Dr. J. H. Potts, New Britain, **13323**, contained 2.68 per cent. of difficultly soluble phosphoric acid.

A sample of bleaching powder, **13398**, sent by Thames Dyeing and Bleaching Co., New London, had 19.27 per cent. available chlorine. Totally unfit for agricultural use.

12948. Sent by L. M. Benham, Highwood, as a potash fertilizer from New Jersey, probably a Sand Marl, contained 2.88 per cent. of potash soluble in strong acid, of which only 0.11 per cent. was soluble in water.

13405. Sent by Robt. A. Warner, Westville, who states that it is a marl mined at Disputanta, Va., which is sold to local farmers at $6.50 per ton.

It contained

Phosphoric acid	0.03
Water-soluble potash	0.02
Total potash	0.11
Lime	47.34
Insoluble in acid	10.55

12094. A fertilizer referred to the station for analysis in a disagreement between chemists was found to contain 1.22 per cent. of nitrogen.

NINETEENTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 19

(Being Bulletin 218 Connecticut Agricultural Experiment Station)

BY

W. E. BRITTON, PH.D.

State Entomologist

NEW HAVEN, CONN.

1920

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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NOTE REGARDING AUTHORSHIP.

For bibliographical purposes all matter in this report (Bulletin 218) should be credited to W. E. Britton except where otherwise indicated.

BULLETIN 218

NINETEENTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I submit, herewith, my nineteenth report as State Entomologist of Connecticut for the year 1919. Pursuant to the action of the General Assembly in changing the time of beginning of the fiscal year, the financial statement covers the nine months ending June 30, 1919. As much of the work of the department extends through the summer, the other part of this report covers the season as usual, and includes brief reports of the work of inspecting nurseries, imported nursery stock and bulbs, apiaries, and suppressing the gipsy moth: also separate accounts of the white pine weevil, the pine bark aphid, various borers and other insects attacking corn in Connecticut, outbreak of the green clover worm on beans, chrysanthemum gall midge experiments, progress of mosquito extermination work, and miscellaneous notes on common pests and unusual insects of the season.

Respectfully submitted,

W. E. BRITTON,

State and Station Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1, 1918, TO JUNE 30, 1919.

RECEIPTS.

From E. H. Jenkins, Treasurer	$4,500.00	
Account of 1918, Balance	1,440.71	
State Comptroller, Gipsy Moth Account	541.98	
M. P. Zappe, Automobile Mileage	4.20	
		$6,486.89

EXPENDITURES.

For Field, Office and Laboratory Assistance:	
B. H. Walden,* salary	$1,166.64
M. P. Zappe, salary	1,125.00
K. F. Chamberlain, salary	420.00

* For seven months: remainder paid from mosquito appropriation.

Martha DeBussy,† salary	$336.00		
Gladys M. Finley, salary	222.00		
Other Assistance	169.67		
		$3,449.31	
Printing and Illustrations		50.50	
Postage		30.13	
Stationery		23.37	
Telegraph and Telephone		4.58	
Office Supplies		37.10	
Library		224.62	
Machinery, Tools and Supplies		143.95	
Express Freight and Cartage		3.61	
Traveling Expenses		350.41	
Automobile Tires and Repairs		279.56	
Balance Cash on Hand		1,889.75	
			$6,486.89

Memorandum:—This account of the State Entomologist has been audited by the State Auditors of Public Accounts. The item of $541.98 credited as having been received from the State Comptroller is really a transfer from the appropriation for suppressing gipsy and brown-tail moths and for inspecting imported nursery stock, and covers the time and automobile mileage of members of the department staff while engaged in inspecting imported stock.

The reason for making this financial statement cover nine months instead of a full year is on account of the change in the beginning of the fiscal year from October 1st to July 1st, made by the last session of the Legislature.

Summary of Inspection and Office Work.

305 samples of insects received for identification.
96 nurseries inspected.
88 regular certificates granted.
22 parcels of nursery stock inspected and certified.
57 orchards and gardens examined.
131 shipments, containing 1,075 cases, 1,164,701 plants, imported nursery stock inspected.
44 shipments or 33.5 per cent. found infested with insects or fungi.
317 shipments, containing 924 cases, 1,529,775 imported bulbs inspected.
723 apiaries, containing 6,070 colonies inspected.
48 apiaries, containing 78 colonies found infested with European foulbrood.
22 apiaries, containing 69 colonies found infested with American foulbrood.
2,308 letters written on official work.
121 circular letters.
621 post cards.

† Resigned March 4, 1919.

254 reports of inspection to Federal Horticultural Board.
798 bulletins, etc., mailed on request or to answer inquiries.
51 packages sent by mail or express.
23 lectures and addresses at institutes, granges, etc.

Publications of Entomological Department, 1919.

By W. E. Britton.

Eighteenth Report of the State Entomologist (Bulletin 211), 108 pages, 7 figures, 16 plates; 10,000 copies distributed in May, 1919.

Insects Attacking the Potato Crop in Connecticut (Bulletin 208), 20 pages, 6 figures, 8 plates; 10,000 copies distributed in March, 1919.

Report of Committee on Injurious Insects, Report of Connecticut Vegetable Growers Association for 1918, page 28, 1919.

Report of Committee on Injurious Insects, Proceedings Twenty-Eighth Annual Meeting, Connecticut Pomological Society, page 95, 1919.

The European Corn Borer, Proceedings Twenty-Eighth Annual Meeting Connecticut Pomological Society, page 159, 1919.

Progress in Mosquito Control in Connecticut in 1917. Proceedings Fifth Annual Meeting New Jersey Mosquito Extermination Association, page 100, 1918.

The Iris Borer Again, *Florists' Exchange,* Vol. xlvi, page 531, October 5, 1918.

The Chrysanthemum Midge, *Florists' Exchange,* Vol. xlvii, page 45, January 11, 1919.

Insects Attacking Maples and Elms, *Florists' Exchange,* Vol xlvii, page 1,331, June 28, 1919.

A Tree Protection Institute, *Florists' Exchange,* Vol. xlviii, page 205, August 2, 1919.

Book Review—Washburn's Injurious Insects and Useful Birds, *Science,* Vol. xlix, page 425, May 2, 1919.

Elm Leaf Beetle, *New Hampshire Sentinel,* July 23, 1919.

Automobile Truck Power Sprayers, *American Fruit Grower,* 2 figures, page 6, October, 1919.

Corn Borers, *New England Farms,* June 28, 1919.

Corn Borers, *Connecticut Agricultural College Press Bulletin,* July 10, 1919.

Corn Borers, *Hartford County Farm News,* July, 1919.

Tree Protection Institute, *Hartford County Farm News,* July, 1919.

By W. E. Britton and M. P. Zappe.

Kerosene Emulsion versus Nicotine Solution for Combating the Potato Aphid, *Journal of Economic Entomology,* Vol. 12, page 71, 1919.

By M. P. Zappe.

Aphis Control, Proceedings Twenty-Eighth Annual Meeting, Connecticut Pomological Society, page 145, 1919.

Department Staff

W. E. Britton, Ph.D., *State and Station Entomologist.*

B. H. Walden, B.Agr., *Photographic and Mosquito Work.* Irving W. Davis, B.Sc., *Deputy in Charge of Moth Work.* Max P. Zappe, B.S., *Inspection and General Work.* Kenyon F. Chamberlain,* *Inspection and General Work.* Philip Garman, Ph.D.,† *Research Work.*	*Assistant Entomologists.*
Miss Martha DeBussy,‡ Miss Gladys M. Finley,§	*Clerks and Stenographers.*

H. W. Coley, Westport, A. W. Yates, Hartford,	*Apiary Inspectors.*

Messrs. Walden and Zappe have continued as assistants in the general work of the department. Mr. Chamberlain, who was employed to inspect nurseries in 1918, was reengaged for the season beginning February 24. Mr. Davis was discharged from military service and resumed his duties in charge of the gipsy moth work January 15. During his absence Mr. Ashworth acted as superintendent and deputy.

Dr. Philip Garman, a graduate of the University of Kentucky, class of 1913, was appointed a member of the staff and began his duties September 1. Dr. Garman was a graduate student at the University of Illinois, receiving his doctor's degree in 1916. He was then assistant entomologist at the Maryland Agricultural Experiment Station for three years. Though Dr. Garman may be called upon sometimes to assist in the general work of the department, he will be engaged chiefly in research in connection with injurious and beneficial insects.

Miss Martha DeBussy served as clerk and stenographer from August 26, 1918, to March 4, 1919, when she resigned to accept a position with larger salary. Miss Gladys M. Finley was appointed to fill the position.

Messrs. Coley and Yates have made the inspections of apiaries, as in preceding years, on a *per diem* basis.

Mr. Walden has continued to serve as deputy to the Director in mosquito elimination work, which required nearly all of his time during the summer months. He has done considerable photographic work and has aided in the inspection of nurseries, imported nursery stock and bulbs. He has been in charge of the

* Beginning February 24.
† Beginning September 1.
‡ Resigned March 4.
§ Beginning March 6.

department during the absence of the Entomologist. Mr. J. Kirby Lewis was employed from August 11 to October 4 to inspect nurseries and bulbs. Mr. Geo. D. Stone, who has been on the gipsy moth force, was employed around Milford in April and May, and again in July to examine corn fields over the state. He also helped to inspect nurseries and imported bulbs, returning in October to the gipsy moth work.

All of the regular members of the staff and the temporary assistants mentioned above have rendered faithful and efficient services which have been appreciated.

Chief Lines of Work.

The regular inspection work as provided for by statute, such as the gipsy and brown-tail moth work, the inspection of nurseries, orchards, gardens, etc., the inspection of imported nursery stock and apiaries has been conducted as in former years.

At the suggestion of the Federal Horticultural Board made during the summer, an attempt has been made to examine all bulbs imported from foreign countries. These shipments began arriving about August 1st, and during the next four months we inspected more than three hundred separate shipments containing 924 cases of bulbs.

Mr. Walden has continued as deputy to the Director in charge of the mosquito drainage work of the state, which during the year has for the most part been maintenance. A few new tide gates have been built, and there have been extensions to the drainage systems in a few towns, but no extensive new work has been carried out.

Mr. Zappe conducted experiments in controlling the chrysanthemum gall midge *Diarthronomyia hypogaea* Loew., in two large commercial greenhouses, in the late winter, and has also continued his studies on the life history of an undescribed sawfly of the genus *Itycorsia* which feeds upon Austrian pine.

Messrs. Zappe and Britton have continued the field experiments begun five or six years ago for the control of the insects attacking cucumbers, squashes, pumpkins and melons in Connecticut. The Entomologist has prepared a paper on this subject which was published as Bulletin No. 216.

Dr. Garman, who began his duties September 1, has already worked out the life history of the bulb mite, *Rhizoglyphus echin-*

opus Fumouse and Robin, which up to that time had not been published. The results of his studies are now being prepared for publication.

On account of the menace of the European corn borer, *Pyrausta nubilalis* Hubner, much scouting has been done in various parts of the State to learn whether or not the pest occurred in Connecticut. Though up to this time it has not been found within our State, several borers resembling it were discovered. All are native or long established species, which in themselves need cause no alarm. Many corn fields were visited in late winter and the corn stalks examined in the shock or as left standing in the field. In Milford where borers were found in the stalks, through co-operation with the owners, the stalks were cut and burned in several fields. Mr. George D. Stone was in immediate charge of this work.

Later in the season, Mr. Stone visited a number of towns in each county, and examined the growing corn in the fields, sending to the laboratory specimens of all insects found attacking the corn crop.

In the following pages of this report, the various papers describe in detail these lines of effort.

By action of the General Assembly, the Entomologist is a member of the new Tree Protection Examining Board, and at present he is serving as Chairman of the Board.

The Entomologist has also co-operated with the Farm Bureaus, and has furnished information about insect pests where needed.

Some time and attention during the year has been given to the preparation of papers to be published by the State Geological and Natural History Survey.

INSPECTION OF NURSERIES.

The annual inspection of nurseries commenced on August 7, but on account of the unusual abundance of rainy weather and the arrival of shipments of imported bulbs to be inspected, the work was retarded and not finished until October 29. Most of this inspection work was done by Messrs. Zappe, Chamberlain, Walden, Lewis, Davis and Stone, but occasionally they were assisted by Messrs. Garman and Britton. Mr. Lewis was employed temporarily from August 11 until October 4 for this purpose. Mr. Stone, who had been borrowed from the gipsy

moth force service to inspect corn fields, was also pressed into service to inspect nurseries, but returned to gipsy moth work on October 8. Mr. Davis inspected practically all of the nurseries in the eastern part of the State.

The men were transported chiefly by automobile, but Mr. Stone travelled to many outlying nurseries on his motorcycle.

The system of inspection adopted was similar to that of former years. Where important pests were found the trees or plants were marked, and the owner or manager was instructed to destroy or treat them as the needs of the case required. Certificates were not granted until a written statement was received that the directions had been carried out.

In inspecting nurseries year after year, the same kinds of pests are found though they may vary somewhat in the order of their abundance. Thus in 1919 the number of nurseries infested by our common nursery pests corresponds very closely to that of 1918, and is as follows:—

Insects:—Oyster-Shell Scale 38; San José Scale 19; Spruce Gall Aphid 19; White Pine Weevil 5; Tulip Tree Scale 4; Pine Leaf Scale 3; Scurfy Scale 3; Elm Scale 2; Euonymus Scale 2; Green Apple Aphid, *Chermes cooleyi*, Woolly Aphid, Rose Scale, Pine Tube Moth, Peach Borer and Leopard Moth, one each.

Plant Diseases:—Poplar Canker 5; Black Knot of Plum, Fire Blight, and Crown Gall, one each.

In 32 nurseries no pests were found.

As in 1918, the oyster-shell scale was the most common and abundant pest on nursery stock, and before certificates could be granted many trees and shrubs had to be destroyed. San José scale infestations were about the same as last year. The tulip tree scale was found in four nurseries, but was entirely absent in 1918. The Oriental peach moth *Laspeyresia molesta* Busck was not found in any nursery.

Four new nurseries and one old nursery were inspected in the spring and certificates granted; they were again inspected in the fall and are marked (2) on the list.

Twenty-two packages were inspected and certificates granted.

Of the 83 names on the list of nurserymen for 1919, six are new, the names of two have been changed and three have gone out of business. Six nurseries had not destroyed or treated their infested stock in time to receive certificates before this report

went to press. The acreage devoted to the growing of nursery stock remains about the same as last year.

The list for 1919, with location, acreage, date and number of certificate of each is as follows:—

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919.

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Barnes Bros. Nursery Co.	Yalesville	150	Sept. 9	1003
Beattie, Wm. H.	New Haven	1	Sept. 22	1011
Bertolf Bros.	Sound Beach	25	Oct. 1	1022
Brainard Nursery & Seed Co.	Thompsonville	6	Nov. 5	1055
Braley & Co.	Burnside	1	Sept. 2	995
Bretschneider, A.	Danielson	1	Sept. 11	999
Brown, F. K. (2)	Greenwich	2	Sept. 26	1017
Burr & Co., C. R.	Manchester, Ellington and Durham	500	Sept. 9	1000
Burroughs, Thos. E.	Deep River	3	Sept. 26	1015
Chapman, C. B.	Groton	1	Sept. 11	1006
Chapman, C. E.	North Stonington	4	Sept. 11	1005
Coari & Co. (2)	Norwalk	2	Oct. 10	1042
Conine Nursery Co.	Stratford	50	Sept. 23	1012
Conley, L. D.	Ridgefield	5	Oct. 1	1025
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	1	Sept. 2	990
Conn. Agr. Experiment Station (W. O. Filley, State Forester)	New Haven	1	Oct. 7	1034
Conway, W. B.	New Haven	1	Nov. 6	1059
Crofut & Knapp Farm	Norwalk	20	Nov. 12	1066
Cross Highway Nurseries	Westport	6	Nov. 5	1057
Dallas, Inc., Alexander	Waterbury	1	Aug. 30	989
Elm City Nursery Co., Woodmont Nurseries, Inc.	Woodmont & New Haven	155	Sept. 27	1018
Fairfield Landscape & Nurseries Co.	Cannondale	5	Nov. 10	1063
Falcon's Flight Farms Nursery (B. Austin Cheney, Prop.)	Litchfield	1	Sept. 26	1016
Gardner's Nurseries	Cromwell	10	Oct. 30	1050
Geduldig, Estate of G.	Norwich	1	Nov. 12	1065
Goodwin Associates, Inc., The James L.	Hartford	1	Oct. 21	1048
Heath & Co.	Manchester	1	Sept. 9	1002
Hilliard, H. J.	Sound View	1	Sept. 2	993
Hiti Nurseries (J. H. Bowditch Prop.)	Pomfret Center	5	Sept. 6	996
Holcomb, Irving	Simsbury	1	Sept. 11	1007

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919—*Cont'd.*

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Horan & Son, Jas.	Bridgeport	1	Nov. 4	1053
Houston & Sons, J. R.	Mansfield	4	Sept. 2	991
Hoyt's Sons Co., Inc., The Stephen	New Canaan	300	Oct. 23	1049
Hubbard & Co., Paul M.	Bristol	12	Nov. 1	1051
Hunt & Co., W. W.	Hartford	10	Sept. 15	1008
Isselee, Charles	Darien	10	Nov. 7	1062
Kelley, James J.	New Canaan	1	Oct. 15	1045
Kellner, Herman H.	Danbury	1	Oct. 1	1024
Keso Nursery (J. J. Kelsey, Prop.)	Clinton	1	Sept. 23	1014
Laddin's Rock Nursery (W. L. Marks, Prop.) (2)	Stamford	5	Oct. 6	1031
Larkin Bros., The	New London	1	Sept. 6	997
Long, J. A., Mrs.	East Haven	1	Sept. 30	1020
Mallett Co., George A.	Bridgeport	1	Nov. 3	1052
Maplewood Nurseries (T. A. Peabody, Mgr.)	Norwich	1	Sept. 2	992
Marigold Farm (H. Kelley, Prop.)	New Canaan	2	Sept. 27	1019
McDermott, E. F.	Windsor	1	Oct. 3	1028
Meier & Gillette	West Hartford	2	Nov. 5	1056
Munro, Charles	New Haven	1	Sept. 30	1021
New Haven Nurseries	New Haven	10	Oct. 9	1038
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	30	Oct. 7	1033
New London Cemetery Association (Ernest E. Rogers, Pres.)	New London	1	Nov. 7	1061
New London County Nurseries (W. J. Schoonman, Prop.) (2)	New London and Stonington	5	Dec. 9	1069
North-Eastern Forestry Co.	Cheshire	20	Aug. 26	988
Oakland Nurseries	Manchester	1	Sept. 9	1001
Palmer, Est. of L. M.	Stamford	5	Oct. 1	1026
Park Gardens	Bridgeport	1	Oct. 10	1040
Pequod Nursery Co.	Meriden	15	Sept. 11	1004
Phelps, J. Wesson	Bolton	1	Sept. 2	994
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Oct. 21	1047
Pierson, A. N., Inc.	Cromwell	50	Aug. 23	987
Platt, Co., The Frank S.	New Haven	1	Oct. 7	1035
Pomeroy, Edwin C.	Northville	1	Nov. 6	1058
Purinton, Mrs. C. O.	Hartford	1	Oct. 6	1032
Quality Seed Store	Stamford	1	Oct. 4	1029
Reck, Julius	Bridgeport	1	Oct. 10	1039
Rockfall Nursery Co. (P. Marotta, Prop.) (2)	Rockfall	1	Nov. 4	1054

went to press. The acreage devoted to the growing of nursery stock remains about the same as last year.

The list for 1919, with location, acreage, date and number of certificate of each is as follows:—

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Quality Seed Store	Stamford	1	Oct. 4	1029
Reck, Julius	Bridgeport	1	Oct. 10	1039
Rockfall Nursery Co. (P. Marotta, Prop.) (2)	Rockfall	1	Nov. 4	1054

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919—*Conc'd.*

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Saxe & Floto	Waterbury	1	Dec. 2,	1068
Schleichert, F. C.	Bridgeport	1	Oct. 10	1041
Scott, J. W.	Hartford	5	Nov. 17	1067
Sierman, C. H.	Hartford	5	Oct. 17	1046
South Wilton Nurseries	South Wilton	5	Oct. 9	1036
Stannard Hill Greenhouses (J. E. Brooks, Prop.)	Westbrook	1	Sept. 23	1013
Steck, Charles A.	Bethel	2	Oct. 9	1037
Stratfield Nursery Co.	Bridgeport	4	Nov. 11	1064
Traendly & Schenck	Rowayton	2	Oct. 1	1027
Upson, R. E.	Marion	1	Nov. 6	1060
Verkade, H.	New London	2	Sept. 15	1009
Vidbourne & Co., J.	Hartford	7	Oct. 14	1043
Wallace, Arthur T.	Wallingford	2	Oct. 14	1044
Wild, Henry	Riverside	1	Oct. 4	1030
Wilson & Co., C. E.	Manchester	10	Sept. 9	998
Yale University Forest School	New Haven	1	Sept. 22	1010
Young, Mrs. Nellie A.	Pine Orchard	1	Oct. 1	1023
Total acreage		1,525		

INSPECTION OF IMPORTED NURSERY STOCK.

For the past ten years an attempt has been made by this department to inspect all woody nursery stock, entering the state, that had been imported from foreign countries. The establishment of the Federal Horticultural Board in 1912, and its system of permits and notices adopted soon afterward, made it possible to examine a much larger proportion of shipments entering the State. From that time to the present, nearly all shipments have been examined, but of course it is nearly impossible to intercept all pests that might be brought over. Especially is this true of plants like azaleas and rhododendrons and certain conifers which are usually shipped with a ball of earth about the roots. Then, too, certain insects may crawl out of the cases and escape before the stock is unpacked or even during the operation.

There had been a rapid increase each year in the number of shipments of this kind coming to Connecticut until the war. In 1917 and 1918, the number of shipments dropped off markedly on account of the blockade and scarcity of tonnage in shipping.

After the armistice was signed, however, and shipping again resumed, considerable stock was shipped. The Federal Horticultural Board announced an embargo, Quarantine 37, on most kinds of nursery stock and woody field grown florist's stock to take effect June 30, 1919. Certain kinds of stock like seedling fruit and manetti rose, which are used for propagation and which are shipped with roots bare, will still be allowed to enter under the rules and regulations prescribed by the Federal Horticultural Board. There is an arrangement by which new and promising forms and varieties may be imported through the U. S. Department of Agriculture.

The trade evidently tried to bring into the country as much stock as possible before the new restrictive measures went into effect. Consequently between October 1st, 1918, and June 30, 1919, 131 shipments containing 1075 cases and 1,164,701 plants were received in Connecticut and inspected by members of this department. This is nearly twice the number of shipments and nearly three times the number of cases inspected last year, and an increase of 38 per cent in the number of plants. Forty-four shipments or 33.5 per cent were infested with insects or fungi some of which are pests.

Most of this stock was inspected by Messrs. Zappe and Chamberlain, but Messrs. Walden, Davis, and Britton assisted during the rush season. The time required to inspect this stock amounts to 707.5 hours, or 94.3 days of 7½ hours each, or 3.62 months of 26 working days each.

The sources of this stock are given in the following table:—

SOURCES OF IMPORTED NURSERY STOCK, 1918-1919.

Country.	No. of Shipments.	No. of Cases.
Holland	98	937
France	14	73
England	8	23
Scotland	5	5
Ireland	3	3
Bermuda	2	32
Japan	1	2
Total	131	1,075

The following table shows the quantity of stock as inspected by months:—

Month.	No. of Shipments.	No. of Cases.	No. of Plants.
December, 1918	4	5	20,000
January, 1919	7	55	293,473
February	19	85	70,360
March	9	40	157,107
April	83	242	588,754
May	7	40	34,999
June	2	8	8
Total	131	1,075	1,164,701

Notices were received of five additional shipments containing 35 cases which were not inspected. Three of these shipments were reshipped and sent out of the State, one contained only herbaceous stock, and one was unpacked and the plants distributed before it was possible to inspect them.

As was the situation last year, none of these shipments came directly from Italy, Belgium or Germany.

As in former years, most of the insects and fungi found in the shipments are (1) species which are already present in this country or (2) species which are not important as pests. However, there are some exceptions. Among the insects intercepted when the plants were inspected in 1919, are the Brown-tail moth, *Euproctis chrysorrhoea* Linn., regarded as an important pest but already present in the New England states; European tent-caterpillar *Malacosoma neustria* Linn., a pest of trees in Europe, which though several times intercepted on stock brought into this country, is not yet established here; *Agelastica alni* Linn., and *Emphytus cinctus* Linn., also brought in many times but not established here; *Otiorhynchus sulcatus* Fabr., *Coccus hesperidum* Linn., and the oyster-shell scale are already established in this country. The infestations found during the year are given in detail as follows:—

PESTS FOUND ON IMPORTED NURSERY STOCK, 1918-1919.

44 Shipments Infested.

Insects, etc.

Agelastica alni Linn. on trees. Van Gelderen & Co., Boskoop, Holland.
Amara communis Panz. Trees. Koster & Co., Boskoop, Holland.
Anisodactylus binotatus Fabr. Trees. Visser Bros., Naarden, Holland.
Aphodius granarius Linn. on Taxus. Koster & Co., Boskoop, Holland.
Barypithes pellucidus Boh. Taxus trees. Koster & Co., Boskoop, Holland.
Carabus nemoralis Mull. on trees. Van Heinigen Bros. & Co., Boskoop, Holland.

Clivina fossor Linn. on trees. Van Heinigen Bros. & Co., Boskoop, Holland.

Coccinella 7-punctata Linn. Azaleas. H. M. Hardyzer, Boskoop, Holland.

Coccus hesperidum Linn. on laurel trees. Flandria Societe Anonyme, Bruges, Belgium.

Curculionid larvae. Trees. H. M. Hardyzer, Boskoop, Holland.

Elaterid larvae on shrubs. H. M. Hardyzer, Boskoop, Holland; Van Heinigen Bros. & Co., Boskoop, Holland.

Emphytus cinctus Linn. on Manetti Rose. R. H. Bath, Ltd., Wisbech, England; S. Bide & Sons, Farnham, Surrey, England; Vincent Lebreton, La Pyramid-Trelaze, France; As. Ouwerkerk, Boskoop, Holland; Thomas Smith & Sons, Troon, Scotland; Louis Leroy Nurseries Co., Angers, France.

Emphytus cinctus Linn. larva. E. Turbat & Co., Orleans, France.

Euproctis chrysorrhoea Linn. on fruit trees. Franco-American Seedling Co., Nantes, France.

Falagria sp. D. Prior & Sons, Colchester, England.

Forficula auricularia Linn. on trees. H. M. Hardyzer, Boskoop, Holland.

Lampyrid larva on Juniper trees. Van Heinigen Bros. & Co., Boskoop, Holland.

Lathrobium brunnipes Fabr. on trees. Van Heinigen Bros. & Co., Boskoop, Holland; M. Koster & Sons, Boskoop, Holland.

Lepidopterous pupa on spruce. M. Koster & Sons, Boskoop, Holland.

Malacosoma neustria Linn. on shrubs. Visser Bros., Naarden, Holland.

Milliped on Manetti Rose. Vincent Lebreton, La Pyramide-Trelaze, France.

Mycetaea hirta Mar. D. Prior & Sons, Colchester, England.

Nest of Rats on blue spruces. Harry Koolbergen, Boskoop, Holland.

Noctuid cocoon on trees. Franco-American Seedling Co., Nantes, France.

Pterostichus vulgaris Linn. In soil. Koster & Co., Boskoop, Holland.

Otiorhynchus sulcatus Fabr. Taxus. Van Heiningen Bros. & Co., Boskoop, Holland.

Oyster Shell Scale on Boxwood. Sliedrecht & Co., Boskoop, Holland; Schaum & Van Tol, Boskoop, Holland; Koster & Co., Boskoop, Holland; Visser Bros., Naarden, Holland; Ebbinge & Van Groos, Boskoop, Holland; Van Heiningen Bros. & Co., Boskoop, Holland; H. den Ouden & Son, Boskoop, Holland; C. Van Kleef & Co., Boskoop, Holland; F. J. Grootendorst & Sons, Boskoop, Holland; W. Van & Sons, Boskoop, Holland; As. Ouwerkerk, Boskoop, Holland.

Sow bug on shrubs. K. Kromhout & Sons, Boskoop, Holland.

Spiders eggs, one mass on shrubs. K. Kromhout & Sons, Boskoop, Holland.

Triaena plebeja Gyllh. on trees. Ebbinge & Van Groos, Boskoop, Holland.

Plant Diseases.

Crown Gall on Manetti Rose. S. Bide & Sons, Farnham, Surrey, England; Vincent Lebreton, La Pyramide-Trelaze, France; Thomas Smith & Sons, Troon, Scotland; As. Ouwerkerk, Boskoop, Holland; Louis Leroy Nurseries Co., Angers, France.

INSPECTION OF IMPORTED BULBS.

At the suggestion of the Federal Horticultural Board, an attempt has been made, at least for a definite period, to inspect the imported bulbs entering Connecticut, in order to ascertain whether or not any dangerous pests are liable to be introduced in this way. Bulbs were not prohibited under Quarantine No. 37, and no effort has ever been made before to inspect them in Connecticut. The first to arrive were lily bulbs from Bermuda, then narcissus paper whites from France which began coming in July. Later came tulip and hyacinth bulbs from Holland and lily bulbs from Japan.

The source of the shipments inspected are as follows:—

Country.	No. of Shipments.	No. of Cases.
France	104	302
Holland	147	436
Japan	43	141
China	9	26
Bermuda	4	6
England	10	13
Total	317	924

The inspections by months are as follows:—

Month.	No. of Shipments.	No. of Cases.	No. of Bulbs.
July	1	3	200
August	46	102	71,900
September	57	199	231,835
October	109	334	629,495
November	104	286	596,345
Total	317	924	1,529,775

On November 14, notice was received from the Federal Horticultural Board that arrangements had finally been made for these bulbs to be examined at the ports of entry of Boston, New York, Washington, New Orleans, Seattle, Tacoma and San Francisco by Federal inspectors. Consequently, hereafter, at least until further notice, it will not be necessary for us to examine bulbs.

Most of this inspection work has been done by Messrs. Zappe and Chamberlain, but Mr. Davis has inspected those shipments going into the eastern end of the State and Messrs. Lewis, Garman, Stone, Walden and Britton have all helped at times in the work.

In 67 shipments or 21.1 per cent. pests were found, the most common being the bulb mite *Rhizoglyphus hyacinthi* Boisdv., known in Europe as *R. echinopus* Fumouse & Robin, which was found in 39 shipments. Apparently this mite will attack and injure any kind of bulbs, and also some of the stems growing out of them. Another pest found in imported bulbs is the bulb fly *Merodon equestris* Fabr., which was found in 4 shipments. Both the bulb mite and the bulb fly have been brought into this country many times and are no doubt established here.

The time required to inspect these bulbs is equivalent to one man working 847½ hours or 113 days of 7½ hours each, or 4⅓ months of 26 working days each.

The data regarding the infested shipments of bulbs are as follows:—

PESTS FOUND ON IMPORTED BULBS, 1919.
67 Shipments Infested.
Insects, etc.

Atheta sp. C. J. Speelman & Sons, Holland (1).

Capsid bug. Van Zonneveld Bros. & Philippo, Holland (1).

Cathartus advena Wal. C. G. Van Tubergen, Jr., Haarlem, Holland (1).

Elaterid larva in hyacinths. C. J. Speelman & Sons, Sassenheim, Holland (1).

Lepidopterous larvae in buckwheat chaff. L. Van Leeuwen & Son, Holland (5); M. Van Waveren, Holland (1); C. J. Speelman & Sons, Sassenheim, Holland (1); Baartman & Koning, Sassenheim, Holland (1).

Merodon equestris Fabr. L. Van Leeuwen & Son, Sassenheim, Holland (1); M. Veldhuyzen Van Zanten & Son, Lisse, Holland (1); J. Schilpzand & Sons, Hillegem, Holland (1); Van Zonneveld Bros. & Philippo, Sassenheim, Holland (1).

Pyralis farinalis Linn. in buckwheat chaff. L. Van Leeuwen & Son, Sassenheim. Holland (1); C. J. Speelman & Sons, Sassenheim, Holland (1).

Rhizoglyphus echinopus Fumouse and Robin. A. & L. Bremond Freres, Ollioules, France (1); Guldemond & Son, Lisse, Holland (4); Meskers Bros., Holland (1); K. Van Bourgondier & Son, Hillegem, Holland (3); C. Colyn & Son, Voorhout, Holland (1); M. Veldhuyzen Van Zanten & Son, Lisse, Holland (2); J. Schilpzand & Sons, Hillegem, Holland (2); Lagarde & Speelman, Ollioules, France (2); Van Zonneveld Bros. & Philippo, Sassenheim, Holland (5); Vandervooit Alkemade, Naardwyk, Holland (1); L. Van Leeuwen & Son, Island of Guernsey (2); D. Nieuweuhuis & Sons, Lisse, Holland (1); C. J. Speelman & Sons, Holland (5); Zanbergen Bros., Valkenberg, Holland (1); Drevon-Tegelaar & Co., Ollioules, France (1); M. Van Waveren & Sons, Hillegem, Holland (3); Van Meeuwen & Tegelaar, Lisse, Holland (3); Richachiro Tanoi, Yokohama, Japan (1).

Sitodrepa panicea Linn. Van Zooneveld Bros. & Philippo, Sassenheim, Holland (1).
Staphylinids in narcissus. Zaubergen Bros., Valkenberg, Holland (1).
Tenebrio molitor Linn. in chaff packing. L. Van Leeuwen & Son, Holland (1); C. G. Van Tubergen, Jr., Holland (1).
Tenebrio sp. (?) in buckwheat chaff. Van Zooneveld Bros. & Philippo, Holland (2); Baartman & Koning, Sassenheim, Holland (1).
Typhoea fumata Linn. C. G. Van Tubergen, Jr., Haarlem, Holland (1).

Fungi.

Papulospora sp. L. Van Leeuwen & Sons, Sassenheim, Holland (1).
Penicillium sp. L. Van Leeuwen & Sons, Sassenheim, Holland (1).

INSPECTION OF APIARIES.

There has been no change in the personnel of the inspectors or in the system of inspecting apiaries, during the year; Mr. H. W. Coley of Westport has inspected in Fairfield, New Haven, Middlesex and New London Counties, and Mr. A. W. Yates of Hartford has inspected in Litchfield, Hartford, Tolland and Windham Counties, each working on a *per diem* basis.

On account of the change in the fiscal year, all work done prior to July 1, 1919, was paid for out of the old appropriation, leaving a balance of $43.70. The General Assembly increased the appropriation from $750.00 to $2000.00 annually, the new and increased appropriation becoming available July 1, 1919. The wages of the inspectors were increased July 1 from four to five dollars per day, which accounts in part for the increased cost of inspection per apiary and per colony, over former years. The report of the inspection work for the entire season is contained in this paper.

The General Assembly at the request of the Connecticut Beekeepers Association enacted a law, requiring beekeepers to register with the town clerks of their respective towns, as follows:—

CHAPTER 174, PUBLIC ACTS OF 1919.

An Act concerning Registration of the Owners of Honey Bees.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Every person owning one or more hives of bees shall, annually, on or before the first day of October, make application to the town clerk of the town in which such bees are kept, for the registration of such

bees, and such town clerk shall issue to such applicant a certificate of registration upon the payment of a recording fee of twenty-five cents, which certificate shall be in the form prescribed and upon blanks furnished by the commissioner of domestic animals and shall be recorded in the office of such town clerk.

Sec. 2. A record of such registration with the name and place of residence of the registrant and the definite location in the town where bees are kept by him shall be recorded in a separate book in the office of the town clerk, which records shall be accessible to the public.

Sec. 3. Any owner of bees who shall fail to register as required by the provisions of this act shall be fined not more than five dollars.

Approved, May 1, 1919.

This law will enable the inspectors to find the apiaries, so that in localities where diseases occur, it will be much easier to eradicate them.

During the season, 723 apiaries, containing 6,070 colonies, were inspected. The record for 1918 was 385 apiaries, and 2,913 colonies. In making these inspections, 102 towns were visited as against 83 last year. Inspections were made in the following towns which were not visited last year:

Fairfield County—Bridgeport.
New Haven County—Branford, Cheshire, Guilford, Hamden, Meriden, Oxford and Wolcott.
Middlesex County—Durham, East Haddam, East Hampton, Killingworth, Middletown, Portland, Saybrook and Westbrook.
New London County—Lisbon, Stonington and Groton.
Litchfield County—Bethlehem, Harwinton, Thomaston, Torrington, Warren and Washington.
Hartford County—Avon, East Hartford, Glastonbury, Granby, Manchester, Marlborough, Rocky Hill, Southington, West Hartford, Wethersfield and Windsor.
Tolland County—Andover, Bolton and Tolland.
Windham County—Brooklyn, Putnam, Thompson and Woodstock.

On the other hand, several towns in which inspections were made in 1918 were not visited this year. These are as follows:—

Fairfield County—Trumbull.
New Haven County—Ansonia.
Litchfield County—Colebrook, Cornwall, Goshen, Kent, New Hartford, Norfolk, Canaan, Salisbury, Sharon and Winchester.
Tolland County—Columbia, Ellington and Somers.
Windham County—Ashford, Canterbury and Chaplin.

In Avon, Oxford, Saybrook and Westbrook no inspections had ever been made until 1919. There still remain twelve towns where inspections have never been made, as follows: Tolland County, Union; Windham County, Eastford; Fairfield County, Sherman and New Fairfield; New Haven County, East Haven; Middlesex County, Essex, Chester, Middlefield and Old Saybrook; New London County, Lebanon, Preston and Voluntown. An effort will be made to inspect some of the apiaries in these towns next year.

The inspections made during 1919 show that the European foul brood continues to decrease as has been the case each year for the past ten years since the inspection service began. In 1910 when the first inspections were made, 75.9 per cent of the apiaries and 49.7 per cent of the colonies had European foul brood. In 1919, the infestation was only 6.6 per cent of the apiaries, and 1.2 per cent of the colonies. During the past season European foul brood was found in the following 34 towns:—Fairfield County, Bridgeport, Norwalk, Redding and Stamford: New Haven County, Cheshire and Wolcott: Middlesex County, Durham: New London County, Norwich and Old Lyme: Litchfield County, Bethlehem, Bridgewater, Thomaston, Torrington, and Watertown: Hartford County, East Hartford, Farmington, Glastonbury, Granby, Manchester, Marlborough, New Britain, Plainville, West Hartford, Wethersfield, Windsor and Windsor Locks: Tolland County, Coventry and Vernon: Windham County, Brooklyn, Killingly, Pomfret, Scotland, Sterling and Windham.

American foul brood was first found by the inspectors in 1914, and since then in two or three places each year, but the percentage of apiaries infested has never been much above one per cent, or of colonies one-third of one per cent, until 1919, when 3.0 per cent of the apiaries and 1.1 per cent of the colonies were found infested. The disease, therefore, has been more prevalent and infests a higher percentage of apiaries than ever before. One of the principal centers of infestation was Wallingford, where twenty-seven colonies in eleven apiaries were found diseased. It was also present in the following eight towns;—Stamford, Shelton (Huntington). Wallingford, Madison, Killingworth, East Lyme, Waterford and East Hampton. These towns are all in

Mr. Coley's territory in the southern half of the State, and must be given particular attention next year.

The statistics of the apiaries examined in 1919 in each of the 102 towns are given by counties in the following tables, the summary occurring on page 134.

APIARIES INSPECTED IN 1919.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Fairfield County:				
Bethel	2	0	5	0
Bridgeport	4	1	100	2†
Danbury	9	0	90	0
Darien	3	1	26	1§
Easton	2	1	86	1§
Fairfield	9	0	193	0
Greenwich	12	0	166	0
Huntington	1	1	3	1*
Monroe	1	0	2	0
New Canaan	5	1	37	1†
Norwalk	10	2	97	5†
Redding	6	0	64	0
Ridgefield	7	0	69	0
Stamford	21	6	230	7‡
Stratford	2	0	63	0
Westport-Weston	10	0	120	0
Wilton	13	0	156	0
	117	13	1,515	18
New Haven County:				
Beacon Falls	1	0	28	0
Branford	5	1	41	4§
Cheshire	7	1	58	1†
Derby	2	0	47	0
Guilford	3	1	34	5‖
Hamden	7	1	28	1†
Madison	7	2	29	2*§
Meriden	18	0	146	0
Middlebury	1	0	34	0
Milford	1	0	52	0
Naugatuck	6	0	37	0
New Haven	3	0	28	0

* American Foul Brood.
† European Foul Brood.
‡ 2 American Foul Brood, 1 European Foul Brood and 4 Sacbrood.
§ Sacbrood.
‖ Paralysis.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Oxford	3	0	25	0
Prospect	6	0	53	0
Seymour	2	0	26	0
Wallingford	20	11	155	27*
Waterbury	6	0	26	0
Wolcott	2	1	14	1†
	100	18	861	41
Middlesex County:				
Durham	5	3	114	11¶
East Haddam	4	0	47	0
East Hampton	3	1	36	4*
Killingworth	2	1	11	2*
Middletown	1	0	31	0
Portland	3	0	30	0
Saybrook	2	0	20	0
Westbrook	1	0	8	0
	21	5	297	17
New London County:				
East Lyme	5	3	69	5*
Groton	4	0	6	0
Lisbon	1	0	8	0
Montville	6	0	42	0
New London	3	0	42	0
Norwich	9	1	106	1†
Old Lyme	2	1	53	2†
Stonington	1	1	20	2‖
Waterford	5	2	46	18*
	36	8	392	28
Litchfield County:				
Bethlehem	3	1	3	1†
Bridgewater	9	1	65	1†
Harwinton	2	0	7	0
Litchfield	13	0	153	0
New Milford	8	0	79	0
Plymouth	7	0	19	0
Thomaston	8	1	49	1†
Torrington	7	1	133	1†
Warren	4	0	31	0

* American Foul Brood.
† European Foul Brood.
¶ 10 American Foul Brood, 1 European Foul Brood.
‖ Paralysis.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Watertown	6	3	57	3†
Washington	4	0	137	0
	71	7	733	7
Hartford County:				
Avon	2	0	13	0
Berlin	7	0	75	0
Bloomfield	2	0	159	0
Bristol	11	0	100	0
Burlington	10	0	54	0
Canton	15	0	67	0
East Granby	3	0	19	0
East Hartford	15	1	95	2†
East Windsor	9	0	98	0
Enfield	8	0	39	0
Farmington	21	1	98	1†
Glastonbury	27	4	119	9†
Granby	4	1	48	1†
Hartford	24	1	99	1‖
Manchester	14	1	87	1†
Marlborough	2	1	46	3†
New Britain	9	1	100	6†
Newington	4	0	50	0
Plainville	10	3	31	9†
Rocky Hill	3	0	24	0
Southington	5	0	14	0
South Windsor	8	0	32	0
Suffield	9	0	34	0
West Hartford	25	1	117	2†
Wethersfield	11	2	55	3†
Windsor	11	2	28	2†§
Windsor Locks	4	2	13	2†
	273	21	1,714	42
Tolland County:				
Andover	3	0	21	0
Bolton	5	0	16	0
Coventry	11	1	59	1†
Mansfield	5	0	41	0
Stafford	3	0	23	0
Tolland	2	0	4	0
Vernon	8	1	40	2†
Willington	11	0	33	0
	48	2	237	3

European Foul Brood.
Sacbrood.
Paralysis.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Windham County:				
Brooklyn	1	1	2	1†
Killingly	6	2	32	3†
Plainfield	8	0	43	0
Pomfret	15	1	94	2†
Putnam	2	0	11	0
Scotland	5	2	47	2†
Sterling	2	1	9	2†
Thompson	2	0	20	0
Windham	15	1	58	1†
Woodstock	1	0	5	0
	57	8	321	11

SUMMARY.

County	No. of Towns	No. Apiaries Inspected	No. Apiaries Diseased	No. Colonies Inspected	No. Colonies Diseased
Fairfield	18	117	13	1,515	18
New Haven	17	100	18	861	41
Middlesex	6	21	5	297	17
New London	9	36	8	392	28
Litchfield	11	71	7	733	7
Hartford	26	273	21	1,714	42
Tolland	8	48	2	237	3
Windham	10	57	8	321	11
	105	723	82	6,070	167

	No. Apiaries	No. Colonies
Inspected	723	6,070
Infested with European foul brood	48	78
Per cent. infested	6.6	1.2
Infested with American foul brood	22	69
Per cent. infested	3.0	1.1
Sacbrood	9	12
Pee paralysis	3	8
Average number of colonies per apiary		11.2
Cost of inspection		$1,771.03
Average cost per apiary		$2.45
Average cost per colony		.29

† European foul brood.

GIPSY AND BROWN-TAIL MOTH WORK IN 1919.

By Irving W. Davis.*

Assistant and Deputy in Charge of Moth Work.

This work has been conducted as in preceding years, in co-operation with the Federal Bureau of Entomology. Apparently there has been no marked wind-spread of the gipsy moth since 1916, consequently the results of careful and persistent efforts show a rather decided decrease in both the number of infestations and number of egg-clusters in the towns now infested. Moreover, in eight towns considered as infested in 1918, no infestations were found by the Federal Scouts. In seven of these and in three others,—making ten altogether, the quarantine has been removed.

The last session of the General Assembly increased the appropriation for suppressing the gipsy and brown-tail moths, and for inspecting imported nursery stock, to $70,000.00 for the biennial period ending June 30, 1921. The appropriation for similar work for the preceding biennial period was $40,000.00.

Present Status of the Brown-Tail Moth in Connecticut.

For the last three or four years, the brown-tail moth has been very scarce in Connecticut, due it is believed to natural enemies, or at least to natural causes. Consequently it has not seemed advisable for the state to attempt to carry out any control measures, or to order municipalities to take action in the matter. The Report of this Station for 1918, page 286, explains how the number of towns quarantined on account of this insect was reduced from seventy-one in 1915 to thirty-one in 1918. The number was further reduced to twenty-one the past year by the release of the following ten towns:—Stafford, Willington, Ashford, Mansfield, Windham, Franklin, Sprague, Bozrah, Norwich and Preston.

A close watch for winter nests was kept by State men when they were travelling about the State on other work, and likewise

* Note:—Mr. Davis returned January 15, 1919 from service in the U. S. Marine Corps, and since then has been in immediate charge of all field operations. During his absence, Mr. John T. Ashworth served acceptably as Superintendent.—W. E. Britton.

for adult moths around lights during the period of their flight in July. Very few of either were noticed. The Federal Scouts, however, found a few nests in Stonington near the Groton town line in the spring. These were sent to the laboratory at Melrose Highlands, for the purpose of recovering parasites.

FINANCIAL STATEMENT.*

RECEIPTS.

Appropriation for biennial period ending Sept. 30, 1919	$40,000.00
Transfer by Board of Control	103.97
Total Receipts for biennial period	$40,103.97
Amount expended, year ending Sept. 30, 1918	22,644.18
Balance	$17,459.79

CLASSIFIED EXPENDITURES FOR THE NINE MONTHS ENDING JUNE 30, 1919.

Salaries and Wages:		
I. W. Davis†	$ 962.50	
J. T. Ashworth	925.00	
J. A. McEvoy	825.44	
F. C. Rich	827.26	
E. A. Smith	648.45	
R. G. Newton	509.34	
D. LaBelle	708.06	
H. L. Bodo	709.63	
J. W. Longo	429.35	
K. E. Buffington	443.30	
Other labor	3,383.17	
		$10,371.50
Printing and illustrations		6.50
Postage		6.27
Stationery		.20
Telegraph and Telephone		46.73
Office Supplies		53.80
Express, Freight and Cartage		285.94
Machinery, Tools and Supplies		3,200.22
Insurance		389.26
Rental and Storage		127.00
Traveling Expenses		1,004.40
Automobile Tires and Repairs		1,272.28
Inspection of Imported Nursery Stock		665.69
Miscellaneous		30.00
Total		$17,459.79

* The General Assembly at its last session changed the time of beginning the fiscal year from Oct. 1st to July 1st. Hence the classified expenditures cover only nine months.

† For six and one-half months.

Details of Gipsy Moth Work by Towns.

The following pages give a detailed account of the work in each of the infested towns:—

THOMPSON—86 Infestations—2448 Egg-clusters.

In the report of last year a decrease was noted in the number of gipsy moth colonies in Thompson, and it was explained that this was partly due to the fact that single egg-clusters were not counted as infestations. The same practice was followed this year and resulted in finding only eighty-six colonies, as compared with two hundred and seventy-five for the preceding year. These colonies were mostly in the central and eastern portion of the town, there being comparatively few found to the west of the New London and Worcester branch of the N. Y., N. H., and H. R. R. The colonies themselves were smaller than in some of the previous years, the largest containing less than one hundred egg-clusters. In many cases however the egg-clusters were scattered over a large area which made control measures difficult. During the early part of the spring a good deal of undergrowth was cut near many of the colonies, to make the control measures more effective. The larger infestations were also given special attention as were also those which were so located as to make spraying impracticable. Following this the colonies in windswept localities, from which there was great danger of spread of caterpillars, were banded with raupenleim. In the course of the spraying season, both the horse-drawn and automobile truck power sprayers were used in this town, and sixty-seven of the eighty-six colonies were sprayed.

WOODSTOCK—36 Infestations—876 Egg-clusters.

This town was the first one scouted this year, due to the fact that the western portion was not covered in the scouting of a year ago. It was expected that the western section would contain the majority of the colonies and exactly half of those found in Woodstock were located there near Woodstock Valley and from there south to the Eastford line. The northwestern section did not contain any colonies, and the remaining eighteen were scattered throughout the eastern part of the town. In several cases but one tree was infested and wherever possible these trees were cut and burned. A few of the woodland colonies were also

EASTFORD—21 Infestations—173 Egg-clusters.

This town was scouted by the Federal men, and resulted in locating twenty-one infestations containing 173 egg-clusters. There were no colonies found in the extreme northern portion of the town, but in the south and central sections the infestations were well distributed. The most dangerous colony was found on land of Mr. Andrew Chilkott about a mile to the west of Eastford village. The growth here was largely oak and maple, and the egg-clusters were scattered over a considerable area of it. Its location together with the large area it covered rendered it impossible to do any banding, but this entire tract of woodland was sprayed. Another infestation of note was on land of Mr. John Fitts near the Ashford line. This was also in the woodland, but was not scattered as much as the former colony. It was also sprayed during June. Altogether ten of the infestations in Eastford were sprayed and five were cleaned of the undergrowth.

ASHFORD—1 Infestation—1 Egg-cluster.

Mr. H. L. McIntyre of the Federal force found a single egg-cluster of the gipsy moth in Ashford. This was sent to the Government Parasite Laboratory in Melrose Highlands, Mass., and the report from there stated that this egg-cluster was infertile.

KILLINGLY—27 Infestations—755 Egg-clusters.

The twenty-seven colonies of the gipsy moth found in this town were widely scattered, and none of them were considered of a serious nature. Among the larger colonies might be mentioned two which were in the northwestern part of the town and near the state road leading to Putnam. One of them was in two large pasture oaks and 107 egg-clusters were creosoted on these trees. The other colony, a short distance south of the first, was in an old apple tree. This tree was cut, and in the course of cleaning it up 118 egg-clusters were found and destroyed. In the course of scouting for larvae several egg-clusters were found and during June these areas were sprayed making in all thirty-eight different localities in Killingly which were sprayed this year.

BROOKLYN—16 Infestations—1433 Egg-clusters.

During the scouting this past winter, sixteen colonies of the gipsy moth were located here principally in the eastern and southern portions of the town, and among them were some of

the largest colonies found this season. One infestation worthy of note was found on land of Mr. DeMott in the eastern part of the town near the Killingly line. While there were 796 egg-clusters here, the growth was very small consisting of one or two small oak trees. This colony was sprayed early in the season with a hand-sprayer and from later observations it is believed that the colony has been exterminated. Another large colony was found in a maple swamp in the northern part of the town. This infestation was scattered over a large area and was so located that it was not feasible to spray it. The most dangerous colonies in this town were cleaned of undergrowth and during the month of June, fourteen of the colonies were sprayed with arsenate of lead.

HAMPTON—12 Infestations—30 Egg-clusters.

There were very few egg-clusters of the gipsy moth found in Hampton this year as compared with last, when 336 egg-clusters were destroyed. The colonies also were small; the largest containing only seven egg-clusters, and located around the borders of the town while in the central portion none were found. Five of them contained but a single egg-cluster each, and none of them were serious enough to warrant spraying.

MANSFIELD—1 Infestation—1 Egg-cluster.

Mansfield was scouted by the Federal men and their work consisted largely of scouting around the colonies of the previous year. Only one egg-cluster was found near one of these infestations.

STERLING—10 Infestations—216 Egg-clusters.

Sterling was first found infested by the gipsy moth in the winter of 1914-15. Scattering colonies were located during the next two years, but in 1917 a general infestation occurred. The result of the scouting this winter was the finding of ten colonies and several single egg-clusters. Most of the colonies were in the northern section of the town, a few were in the extreme southern portion, leaving an area in the central part where but few traces of the moth were found. The largest colony in the town contained forty-nine egg-clusters in the village of Oneco. This was on the eastern slope of a small hill and the egg-clusters were found in some oaks and a nearby stone wall. The presence of a lot of rubbish and undergrowth made cleaning necessary

and this colony was later sprayed. Other colonies of importance include one of thirty-two egg-clusters found in an abandoned orchard near the Killingly line, and one in the extreme southern part of the town on land of Addie Fenner. These colonies together with four others were sprayed during June.

PLAINFIELD—18 Infestations—756 Egg-clusters.

In this town the infestations were almost all rather large, three of them containing over 100 egg-clusters each. Two of these were in the north part of the town, and one in the south part near the Griswold line. These were all in orchards, which made control measures rather easy. No cleaning was necessary, but all three were sprayed. Several of the colonies in this town were found in pasture oaks. In such cases the nearby brush was cut and burned and wherever possible the infestation was later sprayed. The Federal sprayer was used in this town, and twelve of the colonies were sprayed.

CANTERBURY—10 Infestations—248 Egg-clusters.

Only ten infestations were found as the result of scouting Canterbury this past winter. These may be roughly located in three groups, one in the south part of the town in the vicinity of South Canterbury, another in the central part near Canterbury Plains, and the third in the northwestern corner near the Hampton line. The largest colony was found in an apple tree in the south part of the town. Fifty-eight egg-clusters were found when this tree was cut and as it together with the nearby brush was burned, it was not thought necessary to spray this infestation. In all, five colonies were considered serious enough to spray and in Canterbury this was accomplished by the Federal truck during the early part of June.

SCOTLAND—1 Infestation—3 Egg-clusters.

During the winter of 1917-18 seven infestations containing 136 egg-clusters were located in this town. This year but a single infestation was found and that contained only three egg-clusters. This was not sprayed, as it was not thought to be of sufficient importance.

VOLUNTOWN—3 Infestations—81 Egg-clusters.

Three infestations were found in Voluntown this year, all in the northern part of the town. All were located in apple trees,

and during April all were banded with raupenleim. One colony found on land of Sarah Greene contained seventy-five egg-clusters. Several larvae were found here in the early part of June and during the latter part of the month this infestation was sprayed with arsenate of lead.

GRISWOLD—8 Infestations—16 Egg-clusters.

The gipsy moth colonies in Griswold were all within a small area in the northeastern corner of the town. These colonies were all small and did not require much attention. In the course of the spraying work gipsy moth caterpillars were found at two places on the State road leading from Jewett City to Plainfield. Both of these were sprayed and the finding of several dead larvae a few days later indicated that the work had been effective.

LISBON—1 Infestation—3 Egg-clusters.

Lisbon was scouted by the Federal men during the past winter and only one infestation, containing three egg-clusters, was found.

NORWICH—1 Infestation—11 Egg-clusters.

One colony of eleven egg-clusters was found in the western part of Norwich near the Bozrah line. These were removed and sent to the Government Laboratory and it was later reported that all were infertile.

NORTH STONINGTON—1 Infestation—1 Egg-cluster.

In this town only one egg-cluster was found, and that near an infestation of the preceding year.

LEDYARD—1 Infestation—11 Egg-clusters.

The Federal men scouted this town, and found one colony which contained eleven egg-clusters. This colony was visited by the State men early in the season and as it was in a young apple orchard, the control was easily accomplished.

The following eight towns were scouted by the Federal men and no signs of the gipsy moth were found:

Chaplin	Preston
Windham	Sprague
Franklin	Groton
Bozrah	Stonington

The recent quarantine maps issued by the Government show that ten Connecticut towns have been removed from the area quarantined on account of the gipsy moth, namely:

Ashford	Bozrah
Mansfield	Norwich
Windham	Preston
Franklin	Groton
Sprague	Stonington

The last two—Groton and Stonington—are still quarantined on account of the brown-tail moth.

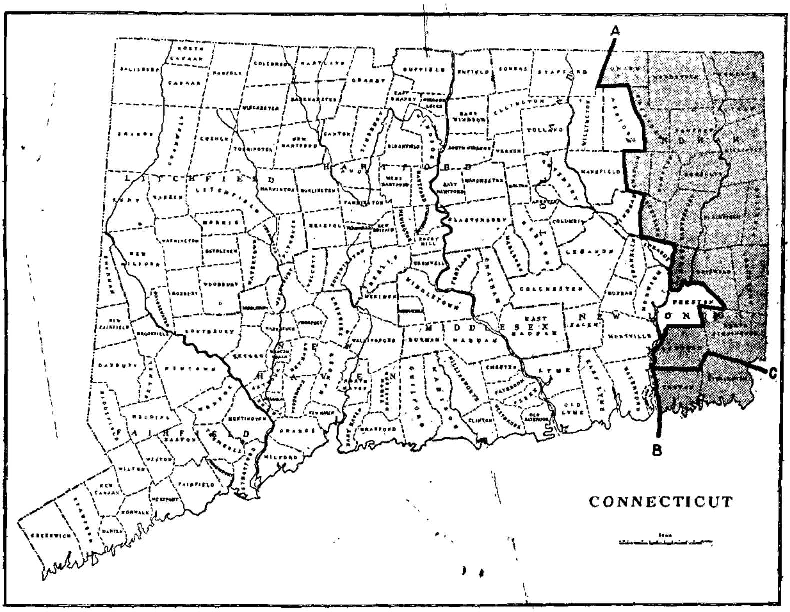

Figure 16. Map of Connecticut showing areas infested by gipsy and brown-tail moths. All territory east of the line A B is quarantined on account of the brown-tail moth. All territory east of the line A C is quarantined because of the gipsy moth.

The Connecticut territory now under Federal quarantine on account of the gipsy moth and the brown-tail moth, includes nineteen towns for the gipsy moth and twenty-one for the brown-tail moth, as shown on the map in figure 16.

STATISTICS OF INFESTATIONS.

The following table summarizes the work by towns:—

	No. of Infestations	No. of Egg Clusters Destroyed	No. of Bands Applied	No. of Infestations Sprayed	No. of Larvae Destroyed
Thompson	86	2,448	221	67	2,881
Woodstock	36	876	173	22	....
Putnam	28	777	219	22	1,564
Pomfret	29	314	35	12	....
Eastford	21	163	36	10	....
Killingly	27	755	399	38	5,988
Brooklyn	16	1,433	246	14	887
Hampton	12	29	241	0	....
Chaplin	0	0	....	0	....
Mansfield	1	1	....	0	....
Sterling	10	216	362	7	337
Plainfield	18	756	492	12	529
Canterbury	10	248	349	5	2
Scotland	1	3	....	0	....
Windham	0	0	....	0	....
Ashford	1	1*	....	0	....
Union	1	1	....	0	....
Voluntown	3	81	86	1	....
Griswold	8	16	185	2	....
Lisbon	1	3	....	0	....
Sprague	0	0	....	0	....
North Stonington	1	1	....	0	....
Preston	0	0	....	0	....
Norwich	1	11*	....	0	....
Ledyard	1	11	....	0	....
Stonington	0	0	....	0	....
Groton	0	0	....	0	....
Bozrah	0	0	....	0	....
Franklin	0	0	....	0	....
	312	8,144	3,044	212	12,188

THE WHITE PINE WEEVIL.

Pissodes strobi Peck.

Notwithstanding the injury caused by the pine bark aphid, the white pine-currant blister rust and various other pests, it may be stated without fear of contradiction that the weevil causes more damage to young white pines in Connecticut than any of them and possibly more than all of them together.

* Egg-clusters infertile

As no comprehensive account of this insect has ever appeared in the reports of this Station, and as frequent requests for information are received and supplied, it is desirable that the facts be brought together in available printed form for the use of the large and increasing number of owners of white pine plantations.

The insect causing this injury is a small brown snout beetle often called weevil or curculio belonging to the family Curculionidae of the order Coleoptera. It was described in the Massachusetts Repository and Journal of January 1817, by Professor W. D. Peck of Harvard University. This paper by Peck is believed to be the first in which an American injurious insect was described.

Thus for more than a hundred years, this weevil has continued to ravage the plantations and natural seedings of white pines in the Northeastern States, and though it seldom kills the trees, it deforms them making them unfit for timber and greatly checks the total or acreage growth.

Ever since the publication of the description of this insect by Peck in 1817, the white pine weevil has been recognized as one of the most injurious pests of pine plantations in this part of the country. It attacks young trees between three and twelve feet in height chiefly, killing the leader or topmost shoot and causing the trunks to become crooked and illshaped. After a tree reaches a height of twelve to fifteen feet, though sometimes weeviled, it is not injured so seriously, but in many cases it takes a long time for the tree to reach that height.

Evidence of Injury.

The first evidences of attack are small clear drops of pitch which ooze out from the punctures on the bark of the leader or topmost shoot. Later this pitch dries to whitish spots and in some cases runs down the stem. This oozing out of pitch may not be very conspicuous, however, and as a rule the owner does not notice anything the matter with his pines until the leaders begin to wilt and droop, usually during the month of July. In Connecticut this first shows early in the month but there are some trees which do not show it until later. The wilted and drooping leaders soon turn brown and die as is shown on plate IX.

Usually the attacks of the insect are confined to the leaders or topmost shoot, but occasionally lateral branches are weeviled,

and rarely weevils are found below the whorl of branches in two-year-old wood. Normally the weevils attack only wood of the previous season's growth.

White pine is the common host and the only forest tree in Connecticut seriously injured by *Pissodes strobi,* though this weevil is recorded as occasionally attacking other pines, and certain kinds of spruces. Small spruces in nurseries (chiefly Norway spruce) are commonly injured by this weevil. There are also other species of *Pissodes* which are found on some of the pines and spruces: for instance *Pissodes approximatus* Hopkins was reared from the thick bark of *Pinus resinosa,* attacking the old wood even down to the ground. Then *Pissodes affinis* Randall breeds in the thick bark of white pine stumps. All three species, *affinis, approximatus* and *strobi,* are found in Connecticut, but it is *strobi* which is responsible for the injury to young white pine trees.

Life History.

There is only one generation each year. Just where the adult beetles hibernate or pass the winter is a question. Hopkins says* "evidently in the ground." Though some closely allied weevils are found during the winter months under the bark of dead trees, stumps, etc., I do not recall ever having seen the white pine weevil in such places. As pupation takes place in the burrows in the leaders of the white pine, it would hardly seem necessary that the beetles go into the ground to pass the winter as adults. But wherever they hibernate they appear in Connecticut about May 1st on the young pines. They feed on the bark for a few days, and soon deposit their eggs in punctures (shown on plate XII, b.) in the bark of the leader or topmost shoot of the previous season's growth. The eggs hatch in from six to ten days, and the minute white grubs at first feed upon the cambium or inner bark, usually going downward and into the pitch. There is great variation in the length of the larval period depending upon food supply, latitude, altitude, etc., but as a rule the larva becomes fully grown in less than two months. It then excavates a larger and deeper burrow or cell in which, surrounded by shreds of wood like excelsior, it transforms. The cells are shown on plate XIII, and in Figure 17. The pupa stage lasts about ten days.

* Circular No. 90. Bureau of Entomology, U. S. Dept. of Agr., 1907.

There is a period of egg laying, so that with the variation in the length of the larval period, it is not uncommon to find the larvae in all stages of development and likewise pupae in the months of July and August. The adults begin to emerge through round holes in the bark as shown on plate XIII, a, the latter part of July and continue into September. Hopkins states* that the principal period of emergence is between July 25 and August 15, and that practically all adults will have emerged by the middle of September. According to Hopkins it is believed that an individual adult weevil may live for two or three years depositing eggs each year. As has already been stated, in Connecticut the adults appear about May 1st, and they are fairly abundant on the pines for five or six weeks. They are also common in

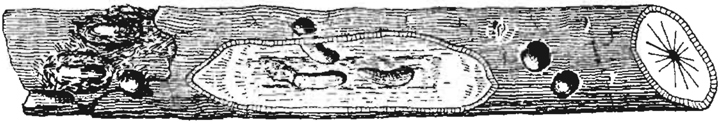

Figure 17. Pupal cases, larval cells and exit holes of the white pine weevil. About twice natural size.

August during the period of emergence. Reared and collected specimens in the Station Collection bear the following dates: April 22; May 1, 7, 8, 13, 14, 15, 17, 22, 29, 31; June 3, 9, 10, 17, 23; July 10; August 3, 9; September 4.

Distribution.

According to all accounts, the white pine weevil occurs from North Carolina northward into Canada and westward into Wisconsin, thus occupying the natural range of the white pine. It will probably be found in every town in Connecticut.

Food Plants.

As has already been stated, the chief injury is to white pine *Pinus strobus* but occasionally it attacks the Scotch pine *Pinus sylvestris,* the jack pine *Pinus divaricata,* the pitch pine *Pinus rigida,* the Norway spruce *Picea excelsa* and the red spruce *Picea rubens.*

* *Loco citato.*

Effect of Injuries.

When the leader of a pine tree dies, the height growth is seriously checked, but whether or not this affects the diameter growth is uncertain as data are not available covering this point. Usually one of the lateral branches in the whorl immediately below the leader grows faster than the others and soon assumes an upright position, taking the place of the fallen leader. This causes a crooked trunk which the tree will outgrow in a few years if no further weevil injury occurs. But possibly and probably the new self-appointed leader may likewise be weeviled the following year, and the axis of the tree is exaggerated in its crookedness.

Occasionally two laterals instead of one will straighten and rival each other for the leadership. If both grow, a crotch or forked trunk is the result. If one is afterward weeviled and the other escapes, no great harm will result ultimately. Occasionally several laterals assume the upright position and make an illshaped tree. Forked and crooked trunks are undesirable in the growth of timber and the checking of the height growth is a serious matter in forest plantations where it is an advantage to obtain the maximum growth in the minimum time to bring the greatest possible return on the investment. If the plantation is a small one for ornament, for windbreak or to cover a watershed, the effects of serious weevil injury are no less important. Weeviled trees are always unsightly and never develop as satisfactorily as uninjured trees.

Kellicott observed* that weeviled trees were more susceptible to the attacks of the pine tip moth *Pinipestis zimmermani* Grote.

Some plantations are very seriously injured by the white pine weevil, many trees losing a leader each season for a period of years, thus greatly interfering with the normal commercial development of the trees. Crooked, forked and otherwise deformed trees are not desirable for the production of timber and a stand of them would probably bring a lower price.

Description.

The adult beetle is about one-fourth of an inch (4.5 to 6 mm.) in length, reddish-brown in color, marked more or less distinctly

* Canadian Entomologist, Vol. xi, page 115, 1879.

by a spot or patch of whitish scales on the apical third of each wing-cover near the median margin. The color varies from light to dark reddish-brown, and the markings also show great variation: in some specimens they are exceedingly distinct while in others they are almost wanting,—the wing-covers being nearly unicolorous. There are small and irregularly arranged patches of white scales on the thorax, the femora, and on the under side of the thorax and abdomen, but these are inconspicuous or wholly wanting in some individuals. Head and legs are colored

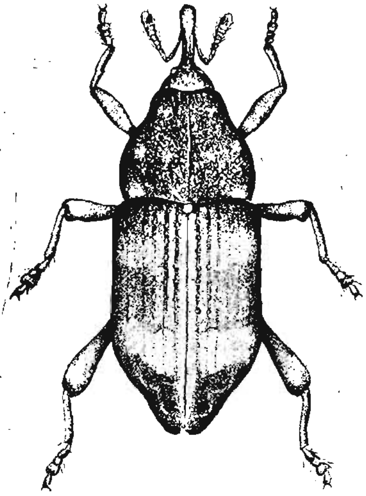

Figure 18. The white pine weevil. Enlarged about six times.

like the body, the head being elongated to form a slender snout after the fashion of the Curculionidae. The length of head and thorax together is only slightly less than that of the wing-covers. The thorax and head are both rather regularly and densely punctured, the punctures arranged chiefly in rows. The wing-covers are covered with horizontal striae with rows of pits in the grooves, the pits being considerably larger and deeper than the thoracic punctures.

The pupa is creamy white and about as long as the adult beetle. The eyes and the tips of the mandibles are brown, and as development progresses toward the end of the pupal stage, brownish color shows on the snout and legs. A pair of slender curved spines are borne at the tip of the abdomen.

The larva or grub is without feet, white and varying in size according to the age or period of development.

The egg has not been carefully studied in Connecticut, but according to Dr. Felt, is globular, whitish, transparent, about one-sixteenth of an inch in diameter and is deposited just beneath the bark. The adult weevil is shown in figure 18, and on plate XII, a, and larva and pupa on plate XIII, c.

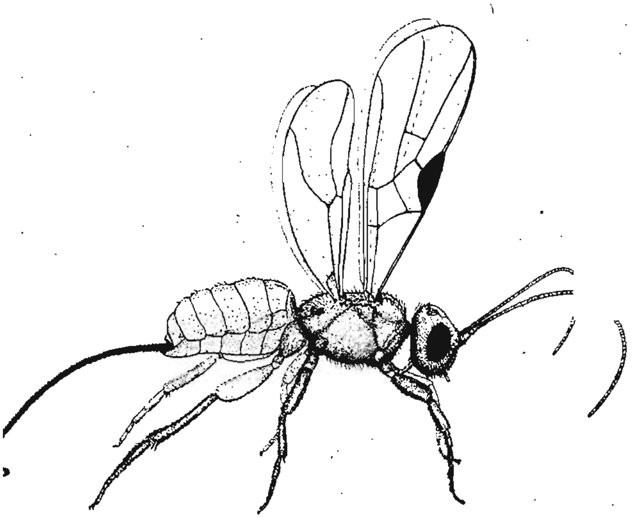

Figure 19. *Habrobraconidea bicoloripes*, a common parasite of the white pine weevil. Eight times enlarged.

Natural Enemies.

A number of natural enemies of the white pine weevil have been recorded. Birds, particularly woodpeckers, tear open the bark covering the cells, and devour the larvae, pupae and also the adults. Hopkins states* that "some of the larvae apparently die from disease, and when large numbers of them are crowded together the larger ones appear to feed on the smaller ones, so that on the average not more than from three to five per cent of the hatched larvae ever reach maturity and emerge from the infested terminals."

In Connecticut, an ichneumon parasite identified by Mr. H. L. Viereck as *Coeloides pissodis* Ashm. was reared from weevils

* Circular No. 90. Bureau of Entomology, U. S. Dept. of Agr., 1907.

collected at Rainbow, town of Windsor, in 1911. A closely allied species *Habrobraconidea bicoloripes* Viereck, shown in Figure 19, has been reared in large numbers from weeviled pine leaders from Rainbow in 1910 and 1912, Yalesville 1912 and Portland 1914, and the parasites have been identified, some by Mr. Viereck and some by S. A. Rohwer. Parasitized material gathered by Mr. Zappe in Portland in 1914 yielded 50 adult weevils and five parasites, showing a parasitism of eleven per cent. The following parasites identified by Mr. Rohwer have also been reared from weeviled material in Connecticut:—*Microbracon nanus* Prov., Portland 1914: *Eurytoma pissodis* Girault, Rainbow, 1912: *Rhopalicus suspensus* Ratz., New Haven, 1914: also *Cyanopterus* sp. from Stafford 1911, which Mr. Rohwer thinks may not be a parasite of the white pine weevil. In West Virginia, Dr. Hopkins reared the ichneumon fly *Spathius brachyrus* Ashm., from the weevils.

Methods of Control.

There are two possible means of reducing the amount of weevil injury as follows:—

(1) To remove and destroy the infested leaders.

(2) To prevent the leaders from becoming injured.

The former can be practiced in large white pine plantations where the latter on account of expense is not deemed practicable, but the latter is preferable in ornamental plantings where it is important to prevent injury and the cost does not matter.

Removing and destroying the leaders after they have been injured reduces the number of weevils and also the injury for the following year, but is it not better, where possible, to prevent the injury and thus save the leaders?

Removing Infested Leaders.

The only method practiced in forest plantations is to cut out all the leaders as soon as they begin to wilt, making the cut with a pair of pruning shears at the base of the leader just above the whorl of lateral branches. The shoots are then gathered and burned before the weevils emerge. If the severed leaders are allowed to remain on the ground for two months or until the beetles escape, the practice would be of no value in reducing their numbers for the next year, though it might improve the appearance of the plantation.

As some of the weevils are parasitized, and the parasites as well as their hosts are destroyed by fire, Dr. Hopkins of the Bureau of Entomology has recommended that the cut shoots be placed in a tight box or barrel with an opening covered with fine wire netting which will allow the small parasites to escape, but through which the adult weevils cannot pass. This arrangement provides for the destruction of the weevils, for they will die in the cage, but allows their parasites to gain the open air so that they may attack and destroy more weevils. Such a cage should be so placed that it will not catch and hold water. It should be in partial shade as it might easily become overheated in full sun so that all insects inside would be killed.

For such a cage, Dr. Hopkins suggests and figures a barrel with wire netting on one or both ends, and a box has been tried in the experimental forest plantation at Rainbow, Conn. At first the wood was so affected by the weather that cracks opened up sufficiently large to allow the weevils to escape. It is very important that the receptacle be tight enough to hold the adult beetles. One of these cages is shown on plate XIV, b.

Protecting the Leaders from Injury.

Simple experiments have been conducted by Mr. Walden and other entomologists of this Station for several years, with a view to discovering some application or other treatment to repel or destroy the adult weevils before they can lay their eggs, and thus save the leaders from injury. In order to be practicable the preparation must repel or poison the weevils without injuring the trees. Such a treatment would be welcome on many estates where pines are planted for ornament or shade and where weevil injury renders them very unsightly. Brief accounts of these tests may be found in the reports of this Station as follows: 1911, page 307; 1914, page 173; 1915, page 134.

Spraying.

It was found that commercial lime sulphur (1 part in 8 parts water) proved to be one of the best repellents tried. At first it was feared that this concentrated mixture, which is the same as is used on dormant trees to kill the San José Scale, would injure the leaves: but such was not the case. When applied at the proper time (about May 1st for most seasons in Connecticut)

only the old leaves are present. By old leaves is meant those of the preceding season's growth. Not the slightest injury could be detected, even where the mixture was applied directly to the foliage. The bark of the leader was coated with lime-sulphur applied with a small compressed air pump that can be carried about, as shown on plate XV, c.

Arsenate of lead, one ounce of the paste in one gallon of water, sprayed upon the leaders also gave some degree of protection, though not quite equal to the lime-sulphur. Both of these materials were tested in a small way in 1911, 1912 and again in 1915, and in nearly every case the weevil damage to the treated trees was less than half that of the untreated trees. In several cases not a single tree was weeviled where sprayed with lime-sulphur. In 1911 sixty per cent. of the check trees lost their leaders.

A number of other preparations were given a trial, and among these "whale-oil" or fish-oil soap, 8 ounces in one gallon of water, seemed to keep off most of the weevils without injury to the trees.

Mr. S. A. Graham of Minnesota has also experimented along this line and finds that creosote and carbolineum are more effective when applied to the leaders than lead arsenate and lime-sulphur, not a single tree being weeviled, though from thirty to forty per cent. of the untreated trees lost their leaders. However, some injury to the trees followed their use.

Mr. Graham also applied bands of tree tanglefoot to a number of pines, one band at the base and another just below the topmost whorl of branches. Very few of these trees were injured, which strongly indicates that the adults crawl up the trunks instead of flying into the tops of the trees. A large number of weevils were liberated in the vicinity of these trees and most of them were afterward found on the trunks below the lower tanglefoot bands.

JARRING.

In 1913, Dr. E. P. Felt, State Entomologist of New York, recommended* collecting the weevils from the pine leaders, using a net of about 15 inches diameter. "This work should begin in April, as soon as the weather is moderately warm, and be con-

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* Tribune Farmer, August 7, 1913; also 29th Report New York State Entomologist, page 32, 1913.

tinued for several weeks at intervals of approximately a week or ten days. Practical work done this season shows that it is possible to make four collections from an acre of young pine at a cost of $1.28 an acre."

Dr. Felt states that at the outset two to four weevils were caught on each tree, but at the last collection only one or two were found in a row of perhaps 400 trees. Using Dr. Felt's experiments as a cue, similar tests were made in Connecticut in 1914 by Messrs. B. H. Walden and M. P. Zappe, about 1800 trees being treated and more than 1000 were under observation as checks.

For this purpose special nets were constructed having a rim about sixteen inches in diameter with a notch about three inches deep on the side to place against the trunk. After trying this net, it was found that more weevils could be captured by placing the net below the base of the leader and close to the trunk and rapping the opposite side of the leader with a stick as shown on plate XIV, a.

The tests were conducted in the State Forest reservations at Rainbow and Portland, on trees between five and eight feet in height, with results as follows:—

Rainbow.

	No. trees	Leaders infested No.	Leaders infested Per cent.
Net used	337	9	2.64
Check	116	8	6.79

Portland.

	No. trees	Leaders infested No.	Leaders infested Per cent.
Net used	1,462	141	8.9
Check	1,009	191	18.9

The season was late and five collections were made at Rainbow, on May 8, 14, 21, 28 and June 3. At Portland four collections were made on May 15, 23, 29, and June 5. Possibly earlier collections would have given better results, though the treated trees in both cases had less than half as many injured leaders as the checks. Probably six collections could have been made at a cost of between $1.50 and $2.00 per acre.

Thus it will be seen that by spraying or by jarring the leaders, it is possible to greatly reduce the amount of weevil injury, and

the cost, though perhaps too great in forest plantations, would certainly be warranted in small ornamental plantations.

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THE PINE BARK APHID.

Chermes pinicorticis Fitch.

There are several species of this genus which suck the sap from the various conifers. Some of these appear on the leaves, twigs or trunks, as bits of cotton or wool and are often called woolly aphids; others, like the spruce gall aphids, form swellings or galls at the base of the new growth, with the young developing inside the galls. In certain species the cotton-like tufts are present on the leaves and twigs and represent the females and eggs or migrants, and the galls on that or another host indicate another stage of the same insect.

It should be stated here that for many years several species of Chermes have been confused in entomological literature, and were disentangled by Dr. Edith M. Patch in her paper on "Chermes of Maine Conifers"* in 1909. The present species

* Bulletin No. 173, Maine Agricultural Experiment Station, 1909.

Chermes pinicorticis was not particularly studied by Dr. Patch, and the available literature regarding the species is based on former studies and observations. Confusion may therefore still exist regarding *pinicorticis* but this cannot be determined until some one has made a careful study of its life history. But disregarding the identity and life history, the damage caused by the insect, its appearance on the trees and control measures are such, we believe, as to warrant the present paper.

The white tufts are common on the needles of young white pine trees, and the white flocculent patches may be seen on the bark of the trunk and branches of both old and young white pines. Not only does the insect occur on cultivated trees, but also on native ones throughout Connecticut. Though the injury from its attack is not well understood, it probably checks the growth and reduces the vitality of the tree, and when abundant may cause serious injury. A slight infestation need cause no alarm.

DISTRIBUTION.

Apparently this insect was first mentioned by Dr. Fitch as occurring in New York State in 1856. According to Storment* it has been recorded from New York, Illinois, Iowa, Maryland and the District of Columbia. Dr. Felt states** that Prof. Lawrence Bruner reported it from Nebraska in 1894. Dr. Patch states† that it occurs in Maine. It is also reported from Canada, Minnesota and Ohio and no doubt the species is very generally distributed, and may be expected to occur in nearly all the intervening territory wherever the white pine is grown. As has already been stated, it is found throughout Connecticut, material having been received from the following localities:—Avon, October 24, 1917: Danbury, June 6, 1914, May 22, 1917: Deep River, July 13, 14, 1915: Greenwich, July 10, 1910, October 4, 1911, June 13, 1913: Hazardville, January 5, 1918: Ivoryton, July 30, 1918: Middletown, June 11, 1907, May 28, 1913: New Canaan, June 22, 1917: New Hartford, July 1, 1909, July 18, 1919: New Haven, May 8, 1907, September 27, 1912: Rainbow, June 13, 1913: Riverside, June 22, 1915: Saugatuck, October 14,

* Insects of Illinois, 20th Report, appendix, pages iii-xxiv, 1898.

** Insects Affecting Park and Woodland Trees, page 193, 1905.

† Bulletin No. 173, Maine Agricultural Experiment Station, page 303, 1909.

1912: South Coventry, December 4, 1917: Southport, June 18. 1912: Sharon, July 2, 1912: Wallingford, July 10, 1914: Westbrook, November 3, 1916.

Appearance and Injury.

The pine bark aphid appears as white tufts of cotton or wool at the base of the needles on the twigs, and as white flocculent patches on the bark of trunks and branches as shown on plates XV and XVI. According to Storment* it occurs more abundantly and more generally on the north exposure of the trunk than on the other sides and around the base, and on the under sides of the lateral branches, indicating that it does not thrive in a strong light. Where there are only a few small scattered patches, they so closely resemble the hardened pitch or gum that without close examination, it is difficult to distinguish one from the other.

There is some question about the exact amount of damage done by the attacks of this insect, though it surely must be considerable in severe infestations. Storment** states that a heavy infestation will kill the lower branches and occasionally the entire tree, and that generally the effect of the infestation is manifest in the shortened leaves and shorter new growth.

Swaine† states that "*Chermes pinicorticis* Fitch is a common and destructive species throughout Eastern Canada, and seriously injures many young white pines, particularly those growing in the shade." Dr. Patch‡ regards it as "a serious enemy to young white pines both in nursery stock and in the open." Finally the Bureau of Entomology§ is responsible for the following statement:—"The pine bark louse (*Chermes pinicorticis* Fitch) was found to be commonly associated with and evidently causes a considerable percentage of the white-pine twig blight which has been so prevalent in the New England States the past year."

Though this insect chiefly attacks the white pine, it is recorded by Dr. C. G. Hewitt|| as causing damage to Scotch pines in Canada.

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* Insects of Illinois, 20th Report, appendix, page iv, 1898.

** Ibid, page iv, 1898.

† 43d Annual Report Entomological Society of Ontario, page 88, 1913.

‡ Maine Agricultural Experiment Station, Bulletin 202, page 160, 1912.

§ Year Book U. S. Department of Agriculture, page 575, 1908.

|| Report of Dominion Entomologist, page 56, 1916.

Life History.

Though the life history of this insect has not been worked out in detail, it is stated that the eggs begin to hatch on or before the first of May, the young emerging in great numbers from the woolly or cottony masses. At first they are very small and hardly discernible with the unaided eye, and they crawl over the bark for a time seeking a favorable place to attach themselves. They usually settle on the tender bark of the young twigs and begin to suck the sap, increasing in size rather rapidly. They soon change to a dark reddish-brown color approaching black, and the waxy secretion soon hides them in a white mass as though it were a tuft of cotton or wool. Winged females appear about the middle of May, but cannot be found two weeks later. Though the full seasonal life history has apparently not been worked out, indications point to several broods during the summer, and the winter is probably passed by wingless females on the bark, more or less covered by the masses of wax, or "wool" as it is called in some of the literature dealing with this insect. It is not known whether the pine bark aphid remains on the pine throughout the entire season or whether it has an alternate host like many other species of aphids.

Natural Enemies.

Like other kinds of aphids, this species is preyed upon by various other insects which no doubt hold it in check under average conditions. The lady beetles are important and those recorded as feeding upon the pine bark aphid are the fifteen-spotted lady beetle *Anatis 15-punctata* Oliv., the two-spotted lady beetle *Adalia bipunctata* Linn., the twice-stabbed lady beetle *Chilocorus bivulnerus* Muls., and the spotted lady beetle *Megilla fuscilabris* Muls., commonly listed as *Megilla maculata* Degeer, a tropical species. The larvae of a syrphid fly, *Syrphus* sp., and of lace-wings or ant-lions, *Chrysopa* and *Hemerobia,* are listed by Mr. Storment as devouring the pine bark aphids.

Control Measures.

As long ago as June 1898, small pines on the Station grounds were infested with a species of woolly aphid which, though not identified at that time, from subsequent observations I am reason-

ably certain was *Chermes pinicorticis*. A single application of "Fir Tree Oil" in the form of a spray rid the trees of these woolly insects.

The most extensive control measures of which I have any record were carried out in June 1911 in the plantation of the Middletown Water Company in the town of Middlefield, Conn. The aphids were abundant on some of the trees and seemed to check their growth. In response to inquiries, I advised spraying the worst infested trees with kerosene emulsion. The superintendent feared that the insect would gain the upper hand and that injury would befall all of the trees; therefore he sprayed the entire 38,000 trees. I visited the place during the operation: 7,000 had already been sprayed. These trees were planted in 1904, consequently were not too large to be sprayed easily. This treatment killed the aphids, the white patches soon disappeared, and there was no material injury to the trees; an occasional slight burning of the needles was observed.

Dr. Felt* states that Dr. E. B. Southwick of the New York City Park Department has found that a driving spray was effective in combating this pest. In some cases, therefore, plain water from a hose if thrown from the nozzle with sufficient force, would prove the best remedy.

Mr. Storment† mentions the experiments in Illinois with kerosene emulsion which proved effective in killing not only the aphids but the eggs also.

In all probability a spray of nicotine solution and soap would also destroy these aphids, though for use in large plantations might prove more expensive than the kerosene emulsion.

Kerosene emulsion may be prepared as follows:—

Kerosene	2 gallons
Common Laundry Soap	1 pound
Water	1 gallon

Dissolve the soap in hot water, add the kerosene, and churn together with pump until a creamy mass is formed which thickens on cooling. Dilute nine times before using.

* Insects Affecting Park and Woodland Trees, Vol. I, page 195, 1905.

† Insects of Illinois, 20th Report, appendix, page xii, 1898.

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EXPERIMENTS TO CONTROL THE CHRYSANTHEMUM GALL MIDGE.

Diarthronomyia hypogaea LOEW.

BY M. P. ZAPPE.

This insect was probably first introduced into Connecticut by florists of the State buying new varieties from other chrysanthemum growers. One grower in particular who grows large quantities of chrysanthemums for cut flowers and cuttings first noticed the work of this insect in 1916, and says that in two years it has caused $5,000.00 damage. Other growers in the State suffered severe losses in 1917 and 1918. Seven towns in Connecticut are known to be infested with this insect, and the pest probably occurs in many others of which we have no record. The following towns are infested:—New Haven, Bridgeport, Hartford, Cromwell, Fairfield, Derby, East Haven.

Experiments were started in January 1919 to find some simple method of controlling this insect. Fumigation with hydrocyanic acid gas had been recommended, but this was quite a costly operation as it was only effective against the adult midges and had to be repeated every few days. There was also danger of burning the foliage by repeated fumigations, and danger to the operator and others who might come in contact with the gas which is deadly to human beings as well as insects.

The eggs of this insect are laid on the top of the plant where the new leaves are unfolding and as the leaves grow larger, the larvae make their way into the leaves. On large plants that are about to bloom the larvae get into the stem and enlarge and weaken it, causing the blossom to droop. Some varieties of chrysanthemums are very liable to attack by midges, while others are almost immune. In a house where several varieties are grown this is very evident. Some will be found badly infested, while others will not have a single gall. See plate XXXI.

The house in which the experiments were conducted was a small one, having a large center bench and a small one on each side. This house had been used for growing seedling pompons and at the time the experiment started the old plants had been cut off. New plants had sprung up from the roots and were about two inches tall. These plants were badly infested with midge galls.

The following treatments were applied:—

Section A. Screened.

Carbolic Acid Emulsion.

The section of the bench where this treatment was applied was screened with cheesecloth which after each spraying was carefully replaced in order to catch emerging adults from this plot and to prevent adults emerging elsewhere from attacking the plants. It was thought possible that the carbolic acid emulsion might penetrate the galls and kill the larvae within.

Crude carbolic acid	¼ pint.
Yellow laundry soap	¼ pound
Water	1 quart

This was prepared in the following manner: the soap was dissolved in hot water, then the carbolic acid was added. This was all churned together until it became creamy. When ready to spray, this emulsion was diluted thirty times. The treatment was applied every three or four days for about two months, beginning January 3, and ending March 3, 1919. After six treatments a few adults began to emerge and later a few eggs were seen. At the end of the experiment after seventeen treatments, there were a few new galls present, but not nearly as many as under the screened check.

Section B. Screened Check.

This section of bench was screened on January 3, and on January 6 one male was found under the screen and another on January 13. On January 31 several adults of both sexes were seen and on March 3rd there were many new galls present on the small leaves.

Section C. Screened.

Nicotine Sulphate 40%.

This was used at the strength of one teaspoonful to one gallon of water plus one ounce of common yellow laundry soap. This treatment was applied every three or four days for two months. There were no adults seen under the screen, so it is safe to assume that they were killed either before they emerged, or while they were emerging. No young galls could be found at the end of the experiment.

Section D. Unscreened.
Check.

On February 3, one month after beginning of experiments, there were many eggs and larvae present on the young leaves. On March 3 there were many young galls present on plants in this section.

Section E. Unscreened.
Arsenate of Lead.

As the eggs of the chrysanthemum gall midge are laid on the surface of the leaves, it seemed to the writer that there might be a time when the young larvae were working their way into the leaves that arsenate of lead would kill them. This was applied the same as the other treatments using one ounce to one gallon of water. At first it looked as though this treatment would be of some value, as this section made a better growth and looked better than the rest. One month after starting the experiment there were many eggs and larvae present and at the conclusion of the experiment there were just as many new galls as on the check section.

Section F. Unscreened.
Fish Oil Emulsion.

This was made similar to the carbolic acid emulsion, except that one and one-half pints of fish oil were used instead of crude carbolic acid. This was diluted ten times. At the end of the first month injury was noticed; the edges of the leaves turned brown and dried up. The dilution was changed to one to fifteen, and at the end of the experiment there were a few new galls present on the young leaves.

Section G. Unscreened.
Powdered Tobacco.

It was thought that this might act as a repellent and prevent oviposition. It was applied by sifting on the top of the plants through a cheesecloth bag. This treatment proved of no value, as there were many new galls present at the end of the experiment.

Section H. Unscreened.

Scalecide.

This was used at a strength of one to twenty, and after a few treatments the edges of the leaves were burned, especially the older leaves. There were no new galls on the leaves that were left on the plant at the end of the experiment.

Section I. Unscreened.

Scalecide.

This treatment was used at a weaker strength than the above, being diluted one to thirty. After two months of treatment there was a slight injury to the leaves, but there were no new galls.

Section J. Unscreened.

Nicotine Sulphate 40%.

This experiment was started about a month later than the others and ended on the same date as the other experiments. At the beginning of the experiment there were many eggs and young larvae present on the new growth. These were all dead three days later. This treatment was applied every three or four days, and continued for a month. At the end of the experiment no new galls could be found.

Another experiment was conducted in a commercial greenhouse, using nicotine sulphate, 1 teaspoonful to one gallon of water and two-thirds of an ounce of soap. This was for the purpose of checking up our other results with the nicotine spray. Young chrysanthemum plants in this house had quite a number of old galls present and were sprayed at intervals of three or four days. The bench treated was mostly of one variety, except the ends, which had a few plants of other varieties. The bench was divided into three parts, both end sections were sprayed and the center section left for a check.

On February 5 the first treatment was given and at this time there were many eggs present, also large galls on the older leaves. The owner of the house began to take cuttings from the sprayed portions of the house on the 27th of February. All these cuttings were put into a propagating house with cuttings from untreated plants from other houses. On March 3 these

cuttings were examined and the sprayed ones were free from young midge galls, and on the untreated ones there were a number of young galls started. There were also a large number of galls present on the check portion of the bench in the house where the spraying was done.

Summary.

From the results of our investigations, it would appear that the best time to combat this insect is while it is still in the egg stage, or shortly afterward before the young larvae are entirely within the leaf.

Scalecide killed all eggs and young larvae, but injured the foliage. 40% Nicotine Sulphate and soap applied every three or four days will control this insect and most florists keep this on hand at all times so that this is probably the easiest and best spray for commercial florists to use.

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PREVALENCE OF GREEN CLOVER WORM ON BEANS.

Plathypena scabra Fabr.

An outbreak of the green clover worm occurred in 1919, and bean plants in nearly all parts of the state were suddenly riddled. At first, the caterpillars which were on the under side of the leaves, dropping to the ground on being disturbed, escaped notice. A careful examination, however, revealed them in large numbers and of all sizes. Both common beans and Lima beans were attacked, and more or less irregular holes eaten in the leaves. In some cases only the veins were left and the pods were also eaten.

Specimens were received from New Haven, Orange and Putnam, and correspondence and telephone calls regarding this insect occupied considerable attention of the office force the last week

in July and the first week in August. The Hartford County Farm Bureau reported twenty telephone calls in one day inquiring about the insect feeding upon beans.

In conversation with other entomologists, I learn that this outbreak was not local, but reached over a large portion of the northeastern United States.

The only prior record on hand of such an outbreak was in 1908, but it was not as severe as that of 1919. An account of the insect with illustrations was printed in the Report of this Station for 1908, page 828. Some of the same illustrations are used herein.

On account of the many complaints and inquiries, the following statement was given out to the press, on August 2, and was printed in many of the newspapers of the state:—

Green Worms Threaten Bean Crop.

"Slender green striped worms are now devouring the leaves of beans in fields and gardens, and unless prompt measures are taken, the entire crop may be destroyed.

Lima and other shell beans should be sprayed with arsenate of lead, using one ounce of the paste or one-half ounce of the dry powder, in one gallon of water. It would be unsafe to apply this poison to string or snap beans which are nearly ready to harvest, but such beans may be treated by spraying the under surface of the leaves with common laundry soap, four ounces in one gallon of water, or nicotine solution, one teaspoonful in one gallon of water with an inch cube of soap dissolved and added. When disturbed, the worms wriggle and drop to the ground, where they can be reached by the contact spray which will kill all of them that it hits. It may be feasible to shake the vines, and spray the ground afterwards."

Injury to Beans.

The injury is caused by the larvae which eat holes in the leaves. These holes are usually rather irregular in shape, and as the injury progresses, only the net work remains. The writer observed many gardens and fields of beans where the leaves were badly eaten. Pole beans, bush beans, shell beans, string beans and Lima beans were all attacked and severely injured.

Some injury was also done to soy beans. In a number of cases the larvae had eaten holes into the pods. At first the larvae do not eat entirely through the leaf, but the upper epidermis remains. In some cases the injury did not go beyond this point, and the leaves showed these holes as peculiar transparent spots.

Food Plants.

Clover is the common food plant of this insect, but occasionally, when abundant, it attacks and injures beans. Other plants attacked are peas, vetch, soy beans, tickweed (*Meibomia* sp.), strawberry and blackberry.

Habits and Life History.

This insect passes the winter in the adult stage and in the vicinity of Washington, D. C., the moths often fly during warm sunny days of winter. They emerge from winter quarters early. Chittenden records three generations annually in the latitude of the District of Columbia, though Coquillett found only two broods in Illinois. The eggs require from four to six days to hatch, and the caterpillars reach maturity in about twenty-five days. From ten to fourteen days are passed in the pupa stage.

In 1908, the first adult that was reared from larvae, emerged on July 24. Another emerged on July 29 from a cocoon formed July 16. The moths do not appear with any particular regularity, but are found throughout the latter part of the summer. Specimens in the Station collection bear dates ranging from June to November.

The larvae usually feed from the under side of the leaves and wriggle violently when disturbed. The small ones drop on silken threads, but those nearly grown drop to the ground, wriggling and throwing themselves about. Different sized larvae are found feeding side by side. The larva is slender, about the same color as the leaf upon which it feeds, and it loops with the front half of the body somewhat after the manner of a Geometrid larva. Many of the partially grown larvae were yellow and had a sickly appearance. Probably such would never transform.

Description.

Egg:—About 0.5 mm. in diameter and 0.35 mm. in height. Globular, somewhat flattened with the upper half deeply grooved. Light in color.

Larva:—About 25 mm. (one inch) in length, about 3 mm. thick in thickest portion near middle from which it tapers slightly toward the head, and considerably toward the posterior extremity. Color light green, striped longitudinally with darker green and fine white or cream-colored lines. Head pale green, shining and hairy. True legs, pale green. There are three pairs of abdominal prolegs in addition to the anal prolegs. Each segment bears dorsally, ventrally and laterally, a number of dark hairs.

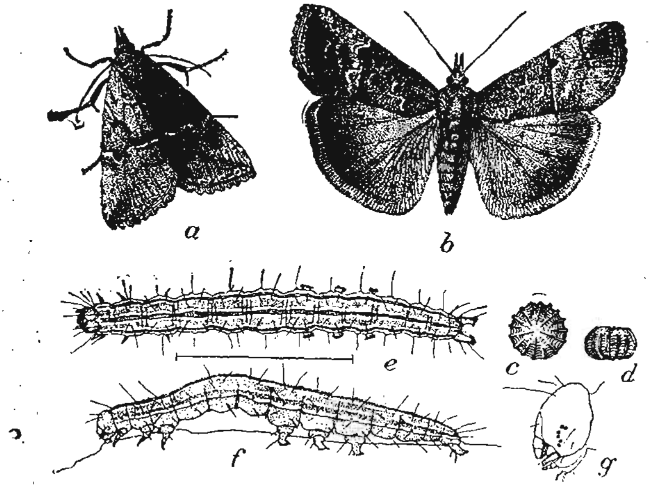

Figure 20. The green clover worm: *a*, moth in natural position with wings folded; *b*, same with wings expanded; *c*, egg from above; *d*, side view of egg; *e*, penultimate stage of larva, dorsal view; *f*, same from side; *g*, head of larva. All enlarged. (After Chittenden, Bulletin 30, Bureau of Entomology, U. S. Department of Agriculture.)

Pupa:—About 12 mm. in length, 3 mm. thick, dark brown in color. A dorsal ridge extends from the head over the thorax and first four segments of the abdomen. Some pupae occur in rolled leaves and are usually enclosed in a white silken web or cocoon of loose texture; others are in the ground in earthen cells formed by webbing together particles of soil.

Adult:—Wing-expanse from 25 to 37 mm. (one to one and one-half inches) blackish or purplish brown in color, with the outer part of the fore wing shaded with light gray, often showing a brownish tinge. The rear wings are broad and well rounded,

smoky brown and without markings. The males usually show less prominent markings than the females, but there is great variation. Body, legs and antennae brown. The palpi are prominently elongated and project in front of the head as is the case with other members of the group of snout-moths. They are also called Deltoid moths on account of the distinctly triangular shape which they assume when at rest with wings folded. The males are usually larger and more nearly of a uniform color than the females.

The appearance of all stages of this insect is shown in figure 20 and on plate XIX of this report.

Control Measures.

In order to make a few tests on controlling this insect, some small plots in Hamden, as shown on plate XVIII, were sprayed by hand on July 31, as follows:—

Arsenate of lead (paste) one ounce in one gallon of water, applied to nine rows.

Black Leaf 40, one teaspoonful, one ounce laundry soap, in one gallon of water, applied to two rows.

A few days later, practically all larvae were dead where the arsenate was applied, and only a few were living on the rows treated with nicotine solution.

In order to ascertain if the contact treatment was immediately effective, the vines were brushed over a piece of paper spread upon the ground, and the spray nozzle passed quickly over the paper on which the larvae had dropped. The three following sprays were tried in this manner:—

Black Leaf 40, one ounce soap, one gallon water.

Black Leaf 40, one-half ounce soap, one gallon water.

One ounce soap, one gallon water.

In each case, all of the younger larvae dropped in their tracks, wriggled slightly and died. The larger ones crawled a short distance, but soon died. In no case were they able to get off the paper after being hit by the spray.

In the writer's own garden, clear water from the hose was thrown with considerable force in the form of a spray against the under sides of the leaves. Most of the larvae were dislodged and I am sure that many of the smaller ones were unable to return to the plants.

LITERATURE.

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PRESENT STATUS OF THE EUROPEAN CORN BORER IN THE UNITED STATES.

In the Report of this Station for 1918, page 316, is given an account of the "European Corn Borer *Pyrausta nubilalis* Hubn.," and its distribution as known at that time. Since this article was written the insect has been discovered in New York State at two widely separated points, namely, near Schenectady and in the western part near Lake Erie. This westernmost infestation also extends into the State of Pennsylvania. Its limits have not yet been definitely determined. An increased area has been found which extends northward into New Hampshire.

MASSACHUSETTS INFESTATION.

Recent examination of the infested area in Massachusetts shows that the pest has spread farther than was known to be the case a year ago. Instead of covering 300 square miles as was estimated last year, probably six times that number is more nearly the size of the present infested area. The original infestation has extended northward into New Hampshire, and has spread southward from Boston along the bay and practically the whole of Cape Cod is infested. The westernmost towns in which the pest has been found are Tyngsboro, Sudbury and Framingham. There are 111 towns, containing nearly 2,000 square miles, in the infested area.

NEW HAMPSHIRE INFESTATION.

The insect was not discovered in New Hampshire until late in the summer and at the time of this writing (November 22, 1919), information just received from the New Hampshire

authorities, states that in that state only the three towns of Seabrook, Plaistow and Kingston have been found infested by the European corn borer. Seabrook is a coast town and joins Massachusetts, but is separated from Plaistow and Kingston by two towns. Plaistow also joins Massachusetts, and Kingston joins Plaistow on the north. Apparently there is no general infestation in New Hampshire.

New York Infestation.

The pest was found in New York State in January, 1919, near Schenectady, where at present twenty-two towns involving the five counties of Albany, Schenectady, Montgomery, Fulton and Saratoga and an area of about 800 square miles, are infested.

Late in the fall a sparse infestation was discovered in the extreme western portion of the State, along the shore of Lake Erie, extending from Angola, Erie County to Fredonia, Chautauqua County, and southward some ten miles, nearly to Gowanda, an approximate area of perhaps 500 square miles. In all of the New York territory, the infestation is less intense, and the injury much less noticeable than in the older infestation in Massachusetts near Boston.

Pennsylvania Infestation.

A slight and scattered infestation has been found in the town of Girard in Erie County, Pa., about two miles south of Lake Erie. Only a few larvae were found in one corn field, and these have been doubtfully identified as those of the European corn borer.

Connecticut Corn Borer a Different Species.

It was mentioned in a foot note on page 316 of the last Report of this Station that borers had been found in corn stalks in Milford, Conn., which might prove to be the European species. At first the larvae seemed scarcely different from preserved material of *P. nubilalis* which the writer collected in eastern Massachusetts in September 1918. Subsequent study of larval characters, however, showed slight differences, and specimens were sent to Dr. E. P. Felt, Albany, N. Y., and to the Bureau of Entomology, Washington, D. C., where they were examined by Mr. Heinrich. Both these entomologists regarded the Con-

necticut material as belonging to the genus *Pyrausta* and probably a native species, but advised that the adults be reared so that the identification would not rest on larval characters alone. It was with considerable interest that we watched the material in the breeding cages, and when no pupae were formed the latter part of May, when adults of *P. nubilalis* should be emerging, it was another indication that our species was something else than the European Corn Borer. The first pupa was noticed on June 26, and the first adult emerged on July 7. During the next few days several other moths appeared. These resembled very closely the specimens of *Pyrausta penitalis* Grote in the Station collection. Specimens were sent to Washington and were identified as a new species since described as *Pyrausta ainsliei* by Mr. Heinrich. This species is discussed more in detail on page 173 of this Report.

Funds for Combating the European Corn Borer.

Soon after the discovery of the borers in corn at Milford, I gave a talk before the Farmers Association of the General Assembly on March 25. It was the sense of the meeting that the State should make some provision for fighting the insect in case the Milford larvae should prove to be the destructive European species. Also in case future infestations should be found it seemed wise to have some appropriation available for controlling the pest and not be obliged to wait until the convening of the next General Assembly. Consequently a bill was drawn up and passed making provisions as follows:—

Chapter 186, Public Acts of 1919.
An Act making provision for the Suppression of the European Corn Borer.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. The board of control, on recommendation of the director and entomologist of the Connecticut agricultural experiment station, at its discretion, is authorized to expend a sum not to exceed ten thousand dollars for the period ending September 30, 1921, for the suppression of the European corn borer. All expenditures authorized by the provisions of this act shall be paid from any unexpended balance in the treasury upon presentation of vouchers approved by the director of the Connecticut agricultural experiment station.

Section 2. This act shall take effect from its passage.

Approved, May 2, 1919.

So far not a dollar of this money has been expended. Nearly $200.00 was expended around Milford in the Spring, but this and the cost of the scouting throughout the State has been paid out of the general appropriation made to the Station for work with insects.

A NATIVE BORER ATTACKING CORN.

Pyrausta ainsliei Heinrich.

Many cornfields were examined during the winter months to see if any trace of the European corn borer could be found in Connecticut. On March 12, Messrs. Zappe, Chamberlain and Codding visited Milford, as this town is a seed-growing center and much seed corn is shipped out from there to all parts of the country. It seemed probable that certain varieties of corn on the ear might have been brought into this region, in order to grow it for seed, and that some of it might have come from an infested section. After examining several fields in Milford the men visited some small plantations on North Street about three-fourths of a mile from the center. Mr. Chamberlain was the first to discover larvae in the cornstalks. Mr. Zappe telephoned to the office that they had found the European corn borer, and I visited the place in the afternoon.

The larvae resembled very closely those in preservative which I had gathered in eastern Massachusetts the preceeding Autumn. In fact we were not able to separate them definitely. Mr. Codding sent specimens to Dr. F. H. Chittenden of the Bureau of Entomology at Washington, who submitted them to Mr. Carl Heinrich, a specialist.

I attended a conference at the State House, Boston, on March 14, and saw Mr. D. J. Caffrey who was in charge of the European corn borer investigations of the Bureau of Entomology, and informed him of the discovery at Milford. At my request, Mr. Caffrey and Mr. W. R. Walton also of the Bureau, visited the region on March 22. We examined some of the infested fields around Milford and they noticed some discrepancies between the injury and that caused by the European corn borer.

Under date of March 15, Mr. Walton wrote that "the specimens were submitted to Mr. Heinrich, yesterday, who examined them carefully and is quite satisfied that they are the larvae of a

species of *Pyrausta*, but he was not willing to make any statement with regard to the species, although he was inclined to believe that it was not identical with *nubilalis*."

Mr. Walton also added:—"However, as our specialists admit that they are not able to distinguish the various species of *Pyrausta* in the larval stages, it seems advisable to proceed on the basis of the supposition that the insect which has been discovered in your State is the European corn borer, as this seems to be the only safe course. I think we all realize by this time that the only way to settle this matter definitely is to rear the adults, and of course that will not be possible for some weeks yet."

As this insect was believed to be the real European corn borer, the following information was given to the press under date of March 15:—"What appears to be a small infestation of the European corn borer was found this week just north of the village of Milford by entomologists of the Agricultural Experiment Station in New Haven. Measures have been taken to suppress the pest."

This notice was printed by many newspapers of the State on March 15 and later. A similar announcement was printed in the Journal of Economic Entomology for April, Vol. 12, page 218.

In April, specimens of the larvae were sent to Dr. E. P. Felt, State Entomologist of New York, who had been making a study of the larvae infesting corn in that State and comparing them with the larvae of other species of *Pyrausta*. Under date of April 8 he wrote as follows:—

"They resemble very closely Massachusetts and New York specimens and for the present we must assume their identity until this is disproved, if it ever is, by rearing."

In looking over Dyar's List of Lepidoptera, I find that there are twenty-five species of *Pyrausta* occurring in the eastern United States, sixteen of which are in the Station collection. As many of these species are unknown in their immature stages, it is not surprising if our specialists are not able to identify the larvae with certainty.

Evidently there was only one way to settle the identity of the Milford corn borer—rear the adults. Here again the Milford larvae did not act quite like the European species; instead of transforming in May as well-behaved European corn borers should, they kept on eating in the old stalks, and the very first

sign of a pupa did not appear until June 26,—more than a month after the time when adults of *nubilalis* should have emerged. It was a period of anxious though watchful waiting.

But meantime forces had not been idle. Preparedness was the watchword. Soon after the borers were found, men were employed to cut, rake together and burn the infested stalks. For, after all, the identity of the borer was uncertain and it might prove to be the dreaded European species. Connecticut could afford to take no chances.

Mr. George D. Stone, a trained gipsy moth scout who had fought with the American Expeditionary Forces in France, and who had been employed by Mr. Davis on gipsy moth work in the eastern part of the State, was brought here to scout for corn borers and to take charge of burning the infested stalks.

A careful scouting was therefore carried on, followed by burning infested stalks, in most cases with the full co-operation of the owner. In some cases the owners cut and burned the stalks themselves under Mr. Stone's direction or supervision. In most of the seed-growing farms in the Milford region, the soil is rather light and the season early. Some of the stalks had already been plowed under before the fields were examined. The stalks were burned in twelve fields having a combined area of about nineteen acres. The owners burned about one and one-half acres without assistance. Mr. Stone burned about four acres without help from the owners, and the remaining thirteen and one-half acres were burned by Mr. Stone and the owners co-operating.

Mr. Stone began this work on March 27 and finished on May 10, covering ground rapidly on a motorcycle. The total cost of this work including wages and expenses was $192.02. Though more attention was given to the Milford area than any other, Mr. Stone visited Wethersfield, Rocky Hill, Cromwell, Middletown, Stratford, Orange, New Haven, Woodbridge and Hamden. In some of these places the larvae were found in cornstalks, and in nearly all of these towns, the stalks of smartweed (*Polygonum*) in the cornfields contained larvae. Messrs. Zappe, Chamberlain and Walden did considerable scouting before and after the discovery of the larvae in the stalks at Milford, visiting in all eighty-five cornfields in various sections of the State; they noticed the tendency of the smartweed stalks to infestation, and finally

on visiting a cornfield, sought at once the low places or depressions where this weed commonly grows. In many cases they found the larvae in the smartweed stalks, and if the insect was abundant in that locality, some larvae were usually found in the corn.

Imagine our interest when the first moth appeared in the breeding cages on July 7, followed by profound relief, for surely it was not the European corn borer *Pyrausta nubilalis.* It was identified provisionally as a native species, *Pyrausta penitalis* Grote, and this identification was later confirmed by Mr. Heinrich at Washington. The larvae resemble very closely the European corn borer, and only an entomologist and a specialist on *Pyrausta* larvae at that, can distinguish them. But their tunnels average somewhat shorter, and there are not so many in a stalk, and so far as my observations go the tassel and ear are not attacked, or if so, not to such a degree as is the case with that destructive pest, the European corn borer.

Injury to Corn Stalks.

As has already been mentioned, no injury to tassels or ears by this insect was noticed in Connecticut. The holes were in the main stalks, usually two or three feet from the ground, and just above a node, though in some cases they were just above the first node, only a few inches from the ground. As a rule, the burrows were not more than two inches long, slanted upward from the entrance and were wider near the upper end. Evidently the larva excavated its burrow to a sufficient size so that it could turn around, for all or nearly all of the larvae were found headed downward. Sometimes there were several holes in a stalk, but usually only one. The most found in any one stalk was nine. Consequently the plants were not much injured, and their vitality and growth were unimpaired. Just why the larvae go into the corn at all is a question. If for food, one would expect them to eat larger tunnels. Possibly it is as a place to pass the winter. Yet many of them hibernate in the *Polygonum* stems, and seem to be none the worse for their rather precarious winter quarters. The appearance of the infested stalks is shown on plate XXII. In many cases the stalks had been pecked into by birds, and the burrows were empty.

Identity.

Though this species was provisionally identified as *Pyrausta penitalis* Grote and in the adult stage resembles that species in collections, recent detailed studies by Mr. Heinrich led him to conclude that heretofore two species have been confused under this name, and that the chief corn-boring species was new and undescribed. As its life history has been carefully studied by Mr. George G. Ainslie, of the Bureau of Entomology, who is stationed at Knoxville, Tenn., Mr. Heinrich has named it *ainsliei*.* At the time that this paper goes to press Mr. Heinrich's description and name of the new species has just been published.

Distribution in the United States.

Apparently this species occurs throughout the eastern United States as it has been found in Massachusetts, Connecticut, New York, New Jersey, Tennessee, Illinois, Missouri and Kansas.

Distribution in Connecticut.

Undoubtedly this corn borer occurs throughout the state, but we have records of it in weeds or in corn from the following towns:—Wethersfield, Cromwell, Middletown, Durham, Meriden, Milford, Orange, Woodbridge, Hamden, New Canaan and Ellington.

Food Plants.

The larvae occur most abundantly in the stems of the larger plants of smartweed or jointweed of the genus *Polygonum*, and particularly in that species sometimes called "Lady's thumb" or "heartsease," *Polygonum Persicaria* Linn. This is the species with a dark blotch on the leaf. I am by no means satisfied that the insect is confined to that species and probably it may occur in any of the larger-growing species of *Polygonum*.

Heinrich states† that "the natural food plants of *P. ainsliei* are *Polygonum*, ragweed, and similar plants: and it is frequently

* Note on the European Corn Borer (Pyrausta nubilalis Hübner) and its Nearest American Allies, with Description of Larvae, Pupae, and One New Species, Journal Agricultural Research, Vol. XVIII, page 171, Nov. 1, 1919.

† Ibid., Vol. XVIII, page 176, 1919.

found in corn associated with *P. nubilalis,* for which its larva is easily mistaken." In several cases, what is believed to be the same borer was found in the stems of "lamb's quarters," "goosefoot" or "pigweed," *Chenopodium album* Linn. Similar larvae were found in stems of "beggar's ticks," *Bidens frondosa,* but as the adults were not reared, it is impossible to be sure of its identity.

Life History and Habits.

The adults emerge in Connecticut the first half of July and soon mate and lay eggs. Our specimens in a large cage over corn plants at the Station Farm at Mount Carmel apparently did not lay any eggs, though there were several individuals present of each sex. Several searches were made, but no eggs could be found. Yet on August 9, small larvae were found boring in smartweed in Hamden, and Mr. Stone found them in Ellington August 11.

Some of the infested smartweed stems were placed in the cage on August 16, and some good-sized uninfested plants of smartweed were transplanted into the cage. Larvae soon left the cut stems and bored into the stems of the growing plants. In September, I noticed that the stems of the smartweed plants were well riddled and several of the larvae were at work in the corn stalks.

Apparently there is only one brood or generation each year in Connecticut, the winter being passed in the stems of plants, particularly in corn and *Polygonum.* The larvae do some feeding in the early summer, pupate late in June, and the adults emerge early in July. The eggs must hatch in July and the larvae spend the remainder of the season tunneling in the stems of plants, often leaving one stem to go to another.

The following paragraph is copied from Mr. Stone's notes:—

"Several instances were observed where the larva had left corn and entered smartweed and *vice versa.* The tunnels were noticeably much shorter where this had taken place, and if anything the borers showed a more mature development. In fields where borers were plentiful, careful observations were made and not a single instance was discovered where a larva had entered a stalk just beneath the leaves. However, many cases were seen where the borer had passed through the sheath of the leaf without entering the stalk at that point. In many cases a semi-circle was

cut in the edge of a leaf directly over the point of entrance into the stalk. The borers entered the stalks on nearly all parts from roots to tassel: the burrows usually were made between the nodes, though in a few cases they occurred directly at the nodes. In smartweed, the entrance was invariably just above the node, and in the majority of cases from two to four inches above the ground, although in a few cases, larvae were found boring in the roots."

Description.

Egg. The writer has not seen the egg-mass of this species, as none were laid by the females reared. Some eggs dissected from the body of a female were white and slightly longer than broad.

Larva. Length about 14 mm., thickness about 2.5 mm., color dirty white or gray to light brown, rather distinctly and conspicuously spotted with darker brown tubercles: dorsally, these tubercles form four longitudinal rows, and there is another row below the spiracles on each side: the tubercles are on the front of each segment forming a transverse row. Beginning with the abdominal segments there are two smaller tubercles on the rear half of each segment. There are also a number of other smaller tubercles definitely arranged. Each tubercle bears a hair. Head dark brown, legs light, unicolorous with ventrum.

Pupa. Length about 12 mm., thickness about 2.5 mm., color reddish brown, somewhat darker on dorsal than on ventral surface, head projecting distinctly beyond base of antennae and ending in a blunt projection. Dr. Edna Mosher has studied this pupa in comparison with that of *nubilalis* and the results have been published.*

Adult. Female wing-expanse about 28 mm., color buff, marked with two submarginal narrow zigzag transverse lines. There is usually a darker shading in the discal area. Head, thorax, abdomen, legs and antennae all about the same color as the wings. Male, usually a little smaller than the female, often darker with similar though usually more prominent markings.

There is great variation in the size, color and markings of both sexes of this species.

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* Journal of Economic Entomology, Vol. 12, page 387, October, 1919.

Control Methods.

The injury to corn by this insect, so far as observed in Connecticut, has not been of such extent or character as to indicate that control measures are necessary. Probably it is only during occasional seasons when the insect is unusually abundant that it attacks corn: the remaining seasons it is probably present in normal numbers in smartweed and nobody pays attention to it. However, if it should again become unusually prevalent and attack corn, the stalks should be cut into short pieces—say one-half inch in length, and put into a silo or fed directly to stock, the same as ought to be done in case of corn infested by the European corn borer. Stalks that are left in the field over winter should be burned before May 1st. The fields should be kept free from a large growth of smartweed, thus greatly reducing the probability of the corn becoming infested.

THE STALK BORER.

Papaipema nitela Guenée.

The common native stalk borer *Papaipema nitela* Guen., and its variety *nebris* Guen., is present every year in Connecticut and infests a large number of plants including corn, bean, potato, eggplant, tomato, rhubarb, spinach, dahlia, aster, chrysanthemum, gladiolus, lily, hollyhock, peony, sunflower, and most of the common vegetables and larger weeds. In fact, it will tunnel in almost any herbaceous stem. Last year I found a larva in the stem of muskmelon near its base. In 1919, of the specimens submitted to the office, one larva from Greenwich was tunneling in the new shoot of a peach tree, this shoot growing near the ground. Another lot of specimens from Putnam included one larva boring in a raspberry cane.

The stalk borer was abundant in 1918, and caused considerable damage throughout the state, but was even more abundant the past season, and did more injury. Also it seemed to attack corn more than other crops, though perhaps the extra attention paid to the corn crop and the inspections made on account of the possibility of finding the destructive European corn borer may be responsible for bringing this injury to light. Thus between June 12 and August 18, which represents the period of the

greatest activity of the larvae as borers, specimens were sent in from the following places:—

Litchfield County—Litchfield and New Hartford.
Hartford County—Hartford, East Hartford, East Windsor, Windsor, Bloomfield, Granby, Canton Center, New Britain and Southington.
Tolland County—Ellington.
Windham County—Putnam, Pomfret and Sterling.
Fairfield County—Greenwich and Stamford.
New Haven County—New Haven, Hamden (Highwood, Whitneyville and Mt. Carmel), Cheshire, Meriden and Clintonville.
Middlesex County—Saybrook Point.
New London County—Lisbon.

In addition to these localities, Mr. George D. Stone, who was employed to examine cornfields throughout the state, sent in material or observed this insect or its ravages in Litchfield, Hartford, Tolland, Windham, New Haven and New London Counties. These records show that the insect not only occurs, but has injured corn the past year in all sections of the state. Probably it was the most noticeable insect pest of the crop during 1919, and also did more damage than any other species.

The injury is of two sorts. When the young larvae attack the corn, they usually feed on the leaves at first near the whorl, eating ragged holes in them, or eating into the leaves before they unroll. This last mentioned form of injury often shows, when the leaf gets larger, as a row of holes across the blade, somewhat after the manner of "bill-bug" injury. Mr. Stone writes: "The *Papaipema* larvae were found nearly everywhere in Windham County, but not abundant. Their work seems to be very distinctive when the corn is young, and later when the leaves grow out, rows of from three to five little holes across the leaf can be observed. Investigation will invariably show that the borer is inside the developing tassel, or if the holes are far out upon the leaf it will be found boring in the stalk."

The larva later does tunnel downward in the stalk, often going quite to its base. In many cases the characteristic leaf injury was present, but on searching for the cause the larva could not be found, and the injury apparently stopped. Probably many larvae are destroyed by birds or predaceous insects before they enter the stalks. Like the army worm this larva is often found in the top of the corn plant in the whorl at the base of the

leaves, and not very well protected. The characteristic leaf injury is shown on plate XXIV.

The larva of the stalk borer is about one and one-half inches long when mature. In its earlier stages it is somewhat smaller, and is distinctly striped lengthwise with brown and white. There is a rather broad lateral white stripe on either side which is interrupted on the first four abdominal segments, thus giving the appearance of a broad transverse band or girdle of dark brown or gray. The larva is shown on plate XXIV, c. In its mature stage just before pupating, the conspicuous stripes gradually disappear, and the larva is a dirty greenish gray color.

The adult is a purplish gray moth with a wing-spread of about one and one-fourth inches. The typical form *nitela* is nearly uniform in color with a transverse submarginal lighter band shading into the darker margin on the forewings. On some specimens rather inconspicuous black spots show in the discal area. The variety *nebris* Guen., resembles the above, except that it has conspicuous white spots in the discal area, and is shown on plate XXIV, b. From the material gathered from corn and other plants in Connecticut, both forms have been reared, but variety *nebris* is much the more abundant.

There is only one generation each year, and the insect probably passes the winter in the egg stage on the stalks of pigweed, ragweed and other common weeds. These eggs hatch early in June, and the young larvae at once feed upon any suitable plant that is available. The stalk borer occurs throughout the United States and Canada east of the Rocky Mountains.

The stalk borer was strongly parasitized by dipterous larvae in 1919. Mr. Stone saw many dead larvae in Tolland County, and by August 15, could find no living ones in Hartford County. Probably by that time they had pupated. Much of the larval material which he gathered in various parts of the state never transformed, but gave up dipterous larvae, the parasites often pupating in the box in transit.

The parasites reared, were identified by Dr. J. M. Aldrich of the Bureau of Entomology at Washington, as *Masicera myoidea* Desv., and emerged from material collected in Windsor, Hartford, New Britain, and New London.

On account of the large proportion of the larvae being parasitized, a small proportion of adults were obtained from the material

gathered in the field, and this condition leads us to believe that the stalk borer may not be prominent next year in Connecticut cornfields.

Control Measures.

When the larvae are feeding upon the leaves at the tops of the corn plants, dry arsenate of lead sifted into the whorl will doubtless kill them. After the larvae have commenced to tunnel inside the stalks, there is no satisfactory or practicable method of control that can be practiced in large fields, other than destroying the infested stalks when found.

With a few choice plants in the garden, it may be possible to cut into the stem lengthwise and destroy the borer. Such methods, however, cannot be practiced under field conditions. The destroying of all the larger weeds in which the caterpillars can live will be an aid in reducing their numbers. Burning the stalks of weeds around the field in late fall or early spring to destroy the eggs is to be recommended where the stalk borer is a serious menace to field crops.

INJURY TO CORN IN CONNECTICUT BY CRAMBUS PRAEFECTELLUS ZINCK.

On July 3, Mr. L. F. Harvey, County Agricultural Agent, brought to the laboratory some corn plants from a field on Townsend Avenue, New Haven, which had been injured in a peculiar manner by a larva boring into the side of the stalk near its base. This field was only three or four miles from the center of New Haven and contained about an acre. It was in grass in 1918, and plowed in the spring of 1919 and planted to corn.

The plants began to look sickly when only a few inches high and the outer leaves turned brown and died: later the entire plant followed suit. An occasional plant escaped attack and was much larger and more vigorous than the other plants in the field. A few hills near one end of the field were not attacked, and these and occasional scattered stalks produced ears. The crop was almost a total loss.

At first we failed to notice the larva at the base of the stalks because it dropped away with the soil from the roots when the

plant was pulled up, and even after noticing its presence, it was difficult to obtain one as it would wriggle away into a crevice in the soil.

Mr. Zappe with Mr. Harvey examined the plants and collected more material. Later, on July 10, the writer visited the field, which had the appearance shown on plate XXV, a.

Each stalk attacked had a hole eaten into one side at or just above the surface of the ground, as shown on plate XXV, d. Apparently there was only one larva in a stalk. The larva causing the injury was nearly always enclosed in a case formed by webbing together particles of soil as is shown on plate XXV, c. At the time this insect was supposed to be the corn web-worm *Crambus caliginosellus* Clem., a common species which causes considerable injury to corn in the middle and southern Atlantic States.

From the material gathered and placed in the insectary, four adults were reared about the first of September, and proved to be *Crambus praefectellus* Zinck., a native species, which has not heretofore been recorded as causing injury to corn.

The larva is about 12 mm. long, 2.5 mm. thick, dirty white to ash-gray in color, rather prominently marked with darker tubercles. Each abdominal segment bears eight: six in a transverse line near the front margin of the segment, the outer ones being below the spiracles: two transversely elongated ones just back of the middle two, but more widely separated. Prothoracic shield whitish and shiny marked with several small dark gray spots. Anal shield peppered with dark gray spots. Head whitish, shiny, mottled dorsally with brown. Legs, prolegs and ventral surface whitish. Each tubercle bears one or more hairs. Appearance of the larva is shown on plate XXV, b.

The adult is a Pyralid moth, having a wing-expanse of from 20-24 mm.: fore wings brown with a longitudinal white band narrowing to a point before reaching the margin. There is also a brown dash nearly bisecting the apical angle of the fore wing, formed by white markings on each side, but this dash is usually darker than the ground work of the wing. There is a narrow, wavy submarginal transverse line of darker brown; between this line and the margin is a row of five black elongated dots or short dashes. The terminal fringe is light brown. Rear wings white, with a brownish tinge in some individuals. Legs and antennae light brown. Adult is shown on plate XXV, b.

Mr. George G. Ainslie of the Bureau of Entomology, Cereal and Forage Crop Insect Investigations, stationed at Knoxville, Tenn., who has studied this and allied Pyralids, informs me that he has records of *praefectellus* being taken on corn from Florida, Arkansas and Tennessee, and on wheat from Indiana, but in no case was the injury of any extent or of any real importance.

Professor C. H. Fernald in "The Crambidae of North America," published in 1896, states that the early stages and food plants are unknown.

There are few references in literature to this species, and most of them are systematic rather than economic. Apparently this is one of the first instances, if not the first, of any serious injury being caused by this insect.

THE ARMY WORM.

Cirphis (Heliophila) unipuncta Haw.

In certain seasons the army worm is present and attacks corn. During the outbreaks, like that of 1896 and 1914 in Connecticut, the larvae may injure any grain, grass or corn crop, but in many other seasons when there is no particular outbreak, a few larvae here and there are found feeding on corn. The larvae feed on the leaves at their base, and are often found in the whorl in the top of the plant. Mr. Stone found some on corn in Tolland County, July 31, and in Hartford County, August 14, but they were not very abundant in cornfields.

There was a local outbreak, however, in the town of Woodbury, where a field of oats was infested with larvae. Mr. Chamberlain visited the place on August 19 in company with the Litchfield County Agent, who reported the case to this office. On that date the oats had been cut and raked into windrows. There were many full-grown larvae beneath the straw, and many pupae were found in the soil. An adult moth was also received from Southport on September 24.

The army worm has two or possibly three broods each season, the eggs being laid on the leaves of grass or grain. The larvae reach maturity in from twenty to thirty days.

Crosby and Leonard* state that the insect passes the winter as a partially grown caterpillar. The full-grown larva is about

* Manual of Vegetable-Garden Insects, page 289, 1918.

one and one-half inches in length, ground color greenish black, striped lengthwise with dark mottled broad and fine white lines. The appearance of the caterpillars is shown on plate XXVI.

A more extended account of the army worm may be found in the Report of this Station for 1914, page 157. In case of an outbreak, it is often necessary to plow a deep furrow with perpendicular side opposed to the line of advance; to plow and harrow the soil just after the caterpillars transform to kill the pupae; arsenical poisons may be applied to any crops not used for food or forage in order to insure them against injury.

THE SMEARED DAGGER MOTH.

Acronycta (Apatela) oblinita S. & A.

The first larva of this species found feeding on corn was collected at Brooklyn, July 8, by the writer, in company with Messrs. Irving W. Davis and George D. Stone. Mr. Stone sent specimens to the office, later, as follows:—Windham County, July 17: New London County, July 23: Tolland County, July 31: Hartford County, August 14.

This caterpillar is brown and hairy. The young ones resemble those of the fall web-worm, though somewhat lighter and more yellow in color. As it passes through its molting stages, it soon takes on a different appearance. In one of these stages—perhaps next to the final one—it has broad longitudinal brown stripes with a narrow dorsal stripe and two broader lateral stripes of yellow. In its final larval stage it is simply a brown hairy caterpillar about one and one-half inches in length and somewhat resembles the larva of *Diacrisia* which is called the "woolly bear."

The adult is a pretty gray moth measuring rather more than two inches from tip to tip of fore-wings, shown on plate XXVII, b. The fore-wings are gray, marked lengthwise with black dashes, and the rear wings are white except for a marginal row of small black dots.

One of the immature caterpillars feeding upon corn is shown on plate XXVII, c. They devour the leaves and are usually near the base of the topmost leaves at the time the tassel first begins to show. Later they may feed anywhere on the upper part of the plant. This insect is probably not a serious pest of corn in

this part of the country, but attacks the crop occasionally and causes slight injury.

The caterpillars have a long and varied list of food plants including smartweed *(Polygonum)*, cat-tail flag, willow, poplar, peach, apple, pear, strawberry, raspberry, blackberry, grape, bean, cotton, asparagus, buckwheat, wheat, oak, hazel, elm, alder, butternut, pine, button-bush, soft-maple, lilac, canna, honeysuckle, clover, corn and grasses. Forbes* records two broods in a season in Illinois, but states that it is single brooded in Canada. A specimen in the Station collection was reared from a larva feeding on white pine in Norwich, collected July 19, 1916, and the adult emerged May 26, 1917. A larva was collected on cat-tail flag, East Haven, July 19, 1908.

This species occurs throughout the eastern United States and Canada, and the larva is sometimes called "the smartweed caterpillar." It is not sufficiently abundant in Connecticut to require treatment.

THE LINED CORN BORER.

Hadena semicana Walk.

Early in the season, a circular letter was received from Dr. E. P. Felt, State Entomologist, Albany, N. Y., stating that the lined corn borer *Hadena fractilinea* Grote had been found in a number of fields in New York state. Consequently we were watching for it and on June 16, one larva was received from Farmington, which seemed to answer the description of *H. fractilinea.* This larva was less than an inch long, and striped lengthwise with brown and white as shown on plate XXI, a. Another was found on corn in Bloomfield June 19. In both cases these larvae were feeding upon the leaves and had not begun to tunnel in the stalk. From the Bloomfield specimen an adult emerged August 9, which seems to resemble *Hadena semicana* more closely than *H. fractilinea,* as it does not have the pale color all along the inner margins of the fore-wings.

H. semicana Walker is mentioned in the Yearbook, U. S. Department of Agriculture for 1905, page 634, as follows:—"*Hadena semicana* Walk. usually classed among the rarer cutworms, occurred in destructive abundance in Mercer County,

* Twenty-third Report Illinois State Entomologist, page 170, 1905.

Pa., during June. A similar outbreak occurred in 1893, in an adjoining county in Ohio."

THE CORN EAR WORM.

Heliothis obsoleta Fabr.

This is the same insect that is so common in the southern states where it is known as the "cotton boll worm," and the "tomato boll worm," because it eats holes into cotton bolls and ripening tomatoes.

It occurs nearly every year in Connecticut, and feeds upon the tips of the immature ears of late maturing sweet corn and field corn late in the season. Sometimes it is locally abundant, and considerable damage results from its attack, but in general the injury is much less severe in Connecticut, which approximates the northern limits of the species, than farther south, where several generations occur. Apparently there is only one brood annually in Connecticut.

That it occurs throughout the state is evidenced by material received from the following localities:—New Haven, Cheshire, Bethany, Northford, Westport, Wilton, Kensington, Rockville, Colchester and New London.

This insect was formerly known as *Heliothis armigera* Hbn., and it is treated under this name in much of the literature of the species.

In Connecticut the moth lays its eggs on the silk of the corn plant, and the young caterpillars feed upon the silk and soon work their way through the husk and devour some of the unripe kernels at the tip of the ear. Sometimes the injury may extend half way down the ear or even to its base, but this is unusual, and in most cases is limited to the tip of the ear. Many eggs are doubtless laid on the silk, and sometimes five or six caterpillars begin to feed there, but they devour each other, so that finally not more than one or at most two remain on an ear. This insect attacks both sweet corn and field corn, but seems to prefer the former and injures it more severely. On October 8, the writer observed sweet corn on sale in the market of Washington, D. C., nearly every ear of which contained a large caterpillar.

The corn ear worm much resembles a cutworm to which it is closely related. When fully-grown it is one and one-half inches

or more in length, and in color it varies widely from light green to a rather dark brown. It is usually striped lengthwise with lighter and darker stripes, but the markings also vary greatly and the most conspicuous stripe is a pale lateral one in the region of the spiracles or breathing pores.

When mature the larva goes into the ground, and in a burrow a few inches below the surface transforms to a smooth brown pupa, slightly less than an inch long. In Connecticut the winter is passed in the pupa stage, but in the southern states where several broods occur, the pupal period varies from two to three weeks.

The adult moth has a wing-spread of about one and one-half inches, ground color of fore-wings buff, with darker brown markings. The markings usually consist of a discal spot and sub-terminal bands, but there is great variation; fringe buff or light brown. The rear wings are cream-color with a broad cross band of dark brown next to the cream-colored fringe. Head, thorax, abdomen, legs and antennae buff like ground color of the fore-wings.

The appearance of an infested ear and the adult moth are shown on plate XXVIII.

There is no good method of controlling the corn ear worm on field corn, but experiments in New Jersey show that on sweet corn it may be held in check by dusting the silk soon after it appears with powdered arsenate of lead and fine sulphur, equal parts. Early planted fields and early maturing varieties usually escape injury. Fall plowing of badly infested fields is to be advised.

OTHER INSECTS ATTACKING CORN IN 1919.

THRIPS.

On June 24, some corn plants were received from Mr. A. G. Davis, Litchfield County Agent, which had been injured by thrips. Some of the insects had been collected and mounted on a microscope slide, and submitted with the plants. This mounted material was divided and a part sent to the Bureau of Entomology at Washington, D. C., where it was identified by Mr. A. C. Morgan, who stated that the slide contained two species,—"two

females of the grass thrips *Anaphothrips striatus* Osborn, and one female of *Plesiothrips (Thrips) perplexus* Beach. Practically nothing is known concerning the habits of the last named species." Apparently all the other specimens from Litchfield represent the grass thrips, which is doubtless the species responsible for the injury on corn.

Similar injury to corn caused by thrips was received from Putnam, June 28, and from West Hartford, July 5; it was observed many times by members of the staff in examining cornfields in various sections of the state. As a rule the injury was not very severe, but confined to a few of the lower or outer leaves on a plant here and there. The surface of the leaf was grooved in white lines in the manner shown on plate XXIX, a, and the injured leaves withered and died very quickly. Treatment would not be practicable in the field, but in the home garden a spray of soap and nicotine solution would rid the plants of these minute insects.

Wireworms.

Corn plants were received on June 27 from Bristol which had been injured by wireworms, as shown on plate XXIX, b. The base of the stalk had been hollowed out and two larvae were present. The species has not been identified. Wireworm injury is occasionally serious and difficult to control, the only practicable measures being cultural ones such as crop rotation, fall plowing and thorough harrowing.

Noctuid Caterpillars.

When examining a cornfield in Hamden, June 30, a green rather stout larva about one inch long with white stripe along each side was taken on corn. No description was made at the time, but it was placed in the insectary and from it was reared on July 9 an adult of *Autographa falcigera* Kirby var. *simplex* Guen. The larva feeds on a great variety of plants chiefly of the cabbage family.

Mr. Stone collected on corn another pale green larva mottled with darker green in Tolland County, July 31, and from it was reared on August 23, an adult of *Mamestra subjuncta* Gr. & Rob. The larva is a general feeder, especially on grasses and weeds.

The writer found in Bloomfield, June 19, a partially grown slender green larva feeding at the base of the corn leaves in the whorl. Its length was about 15 mm., thickness about 2.5 mm., general color grass-green, granular, each segment margined posteriorly on the dorsum with a tinge of yellow. A narrow yellowish stripe extends along each side from head to anal prolegs just below the spiracles. Head, legs and prolegs, green. The body bears a few scattered hairs, which are most pronounced laterally: dorsum almost smooth. Shown on plate XXIX, c.

The same or a similar species was taken by the writer at Brooklyn, July 8, and Mr. Stone observed and sent in specimens from Windham, Tolland, Hartford and Litchfield Counties. Mr. Stone writes that the green larva can nearly always be found upon the upper surface of the leaf and the holes which it eats are irregular. It eats the tender leaves chiefly, and seldom injures the tassel. This larva is somewhat different from that collected in Bloomfield, but may represent a later instar of the same species. Each is about 25 mm. long, 4 mm. thick, and there are faint longitudinal green lines of lighter and darker shades on the dorsum. The lateral stripes also vary from yellow to white and some even show a pinkish tint.

Though some of these larvae went into the ground in July to pupate, no adults have yet been reared, so the identity of the species is unknown.

Some small zebra caterpillars, *Mamestra picta* Harris, were found feeding upon corn at the Station farm Mount Carmel, June 20, by Mr. Zappe. They were brought to the insectary and adults emerged August 25. These caterpillars feed in clusters when young. When mature they are about two inches long, black or dark brown, strikingly marked with yellow. The adult has a wing-spread of one and one-half inches. The thorax and fore wings are reddish brown without prominent markings. The rear wings are nearly white, margined with light brown.

This insect is a general feeder and we may expect to find the caterpillars feeding upon almost any garden or field crop.

THE PARSNIP WEB WORM.

Depressaria heracliana Linn.

On June 23, Mr. G. M. Codding brought to the laboratory some stems of cow parsnips collected in the vicinity of Danbury by Fairfield County Agent L. A. Bevan. The stems had been hollowed out by the larvae burrowing in them, and when received contained several pupae as shown on plate XXX, c.

On July 16 several adult moths emerged: thay have a wing-spread of about one inch, with fore-wings of buff or light brown marked by short longitudinal dashes of dark brown or black: rear wings lighter brown, but with a suffused darker shade near the distal margin. Shown on plate XXX, b.

This insect passes the winter as an adult under loose bark and in other sheltered places, and the eggs are laid in May or June on the leaves. The young greenish yellow caterpillars web together the leaves and devour the unfolding blossom buds. This is quite a serious pest in fields where parsnip and carrot seeds are grown. The mature caterpillar is slightly over half an inch in length, greenish yellow in color, somewhat paler laterally and ventrally, with head, legs and cervical shield shining black. Each thoracic and abdominal segment bears black tubercles, with a hair arising from each. Shown on plate XXX, b.

When nearly mature, the larva leaves the web and enters the stalks, usually through the axil of a leaf and for the rest of its larval existence tunnels inside the stem. The pupa is about half an inch long, with dark brown thorax and light brown abdomen, and is formed inside the stalks. The moths emerge in about three weeks, and there is only one generation each year.

The native food plants are wild carrot, wild parsnip, cow parsnip and other plants of the family Unbelliferae. Messrs. Zappe and Chamberlain collected this insect in stems of wild parsnip in Goshen, July 6. Mr. Zappe observed it on seed parsnips in his garden in Hamden, and from a letter I am sure that the same pest was injuring plants in a garden in Stratford, though the infested plants had been removed prior to a visit by Mr. Walden on June 30.

The only control methods are to remove and destroy occasional infested plants, and after blossoming, the plants may be sprayed or dusted with arsenate of lead.

MOSQUITO WORK IN 1919.

By B. H. Walden.

In 1919 the ditches on the salt marshes which have been drained to eliminate mosquito breeding were maintained as in 1918. This includes approximately 5,000 acres located in the towns of Madison, Guilford, Branford, East Haven, New Haven, Orange and Fairfield. In most of the towns it was possible to obtain the same men that were employed in 1918, although it was necessary in certain cases to pay somewhat higher wages.

The ditches were all gone over in April and May and obstructions removed and the necessary cleaning done to provide good circulation of the water.

During the first half of the season the marshes were comparatively dry and free from breeding. Conditions throughout the latter half of the season, however, were extremely favorable for mosquito breeding. Frequent rains and high tides kept the depressions in the marshes filled with water for periods sufficient to produce extensive mosquito breeding.

An attempt to control this breeding by the means of additional ditching and oiling would have increased the cost of maintenance to more than one dollar per acre, which is the maximum amount that can be expended under the law.

Legislation. Under the law passed in 1917 providing for the elimination of mosquito breeding places,* some of the towns have objected to paying three-fourths of the supervision charges in addition to three-fourths of the labor for maintenance. Furthermore, it has been more or less of a question as how to divide these expenses among the various towns as the amount of supervision in a town depends upon the character of the marshes and the judgment of the man employed in carrying out the work. It was undoubtedly the intentions of those drafting the bill for this law that the cost of supervision be paid directly by the State.

Section 2410 of the General Statutes was therefore amended by the 1919 Legislature to read as follows:—

* Seventeenth Report Connecticut State Entomologist, page 345, 1917.

CHAPTER 21.

AN ACT CONCERNING MOSQUITO BREEDING AREAS.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Whenever any swamp, marsh or other land has been drained to the approval of said director, he shall keep the same in repair and free from obstruction, and construct or repair tide gates or otherwise treat such areas so as to make such work effective. The cost of such maintenance or treatment, not exceeding in any year one dollar per acre, shall be paid by the state, and the town, city or borough within which such place or area is located shall reimburse the state for three-fourths of the amount so expended. Said director shall certify to the comptroller the amount due from any town, city or borough under the provisions of this section, and the treasurer of such town, city or borough, as the case may be, shall pay to said comptroller such amount. All amounts so collected shall be available for expenditures under the provisions of this section. Said director may appoint one or more deputies to supervise the work done under the provisions of this and the preceding section, who may exercise the authority granted to such director, and the expense of said director and said deputies for supervision and inspection shall be included in computing the cost of any such work, but the actual cost of making preliminary inspections and surveys and for the supervision and inspection of the construction and maintenance by the said director or his deputies shall be borne wholly by the state and paid from the funds appropriated for the purpose. The comptroller may advance to said director such amounts, within the appropriation therefor, as are necessary to meet the current expenses for labor authorized under the provisions of this and the preceding section. Any person obstructing the work of examining, surveying or ditching or otherwise treating such mosquito breeding areas, or obstructing any ditch, canal or drain, or the natural outlet of any marsh forming, mosquito breeding areas, shall be fined not more than one hundred dollars or imprisonment not more than ninety days or both.

Section 2. This act shall take effect from its passage.

Approved March 19, 1919.

REPORT OF WORK BY TOWNS.

Madison. The selectmen as in 1918 transferred Mr. Russell Bartlett from the road work to mosquito maintenance from April 14 to September 12. The ditches were cleaned in the spring and attention given them as needed throughout the summer. It was necessary to reopen the outlets of the creeks along Madison Beach at frequent intervals.

Guilford. The ditches were cleaned in the spring by Mr.

Frank Blatchley, who has been furnished by the selectmen for the past two seasons. Although the ditches were gone over two or three times during the season, more labor than was available was needed during portions of the season. The tide gate installed on the Great Harbor marsh in 1918 greatly improved the conditions on the marsh during the past season.

Branford. Mr. L. E. Rice was again in charge of the mosquito work in Branford. Owing to insufficient labor to thoroughly clean the ditches on some of the marshes in 1918, an extra amount of work was necessary this season. The ditches on the Hotchkiss Grove marsh were considerably damaged by musk rats and required extra work to put them in shape.

East Haven. The maintenance work in this town was done in connection with the New Haven work.

New Haven. Laborers were hired by the writer to clean the ditches in the spring. Mr. Draper, after finishing his college work in June, was again employed on the work for the remainder of the season.

The city of New Haven is constructing new tide gates on the West River at Congress Avenue bridge, and a new sewer is being laid in Westville, two improvements which should greatly improve the mosquito breeding conditions in the western part of the city. The tide gates which are nearly completed have the abutments and frame work of reinforced concrete with gates of double three-inch tongue and grooved planks and hung with special hinges. These gates control the water on about 130 acres of marsh between Congress Avenue and Chapel Street ditched in 1917,* which has been flooded much of the time during 1918 and 1919.

The new sewer in Westville will receive the pollution from several factories which for a number of years has been emptied into the upper portion of the West River, causing extensive breeding of *Culex pipiens*†.

Orange. The maintenance work in Orange was continued under the direction of Dr. Phelps. In addition to cleaning the

* Seventeenth Report Connecticut State Entomologist, page 349, 1917.

† Thirteenth Report Connecticut State Entomologist, page 245, 1913.

ditches, the creek that runs into the cove marsh was cleaned for several hundred feet to the north, thus draining a semi-fresh water swamp that was a possible malarial mosquito breeding area.

Fairfield. Mr. Nicholas Matiuck was continued in charge of the mosquito work in Fairfield. The large amount of fresh water mosquito work which is being done in the town requires more attention than the twelve hundred and fifty acres of salt marsh. To adequately handle this problem requires a larger appropriation than has been available in the past.

In the western part of the village of Fairfield is a section known as the Thorpe estate, a low area which was divided into building lots and a number of houses have been built by laborers. The natural drainage was cut off by three streets across the area, and by property owners filling in portions of the main ditch. *Anopheles* larva have been found in the water that collected in rainy weather, and the only method of preventing mosquito breeding was by oiling.

During the past season the old ditch was re-opened and deepened throughout this area and for several hundred feet beyond where it joined a creek in the salt marsh. Tile drains were placed across the three streets: 50 feet of eighteen inch and 140 feet of 12 inch tile was used. A gate was placed on the outer culvert to prevent high tides from flooding the area.

No new mosquito control work was done under the state law during the year, although the writer by request examined marsh areas and made recommendations regarding mosquito elimination in the towns of Westbrook and Groton. In the latter town plans have been made and funds are being raised to drain fifty or sixty acres of salt marsh at Groton Long Point during next season.

COST OF MAINTENANCE WORK FOR 1919.

Madison	$505.38
Guilford	432.28
Branford	409.22
East Haven	25.62
New Haven	804.97
Orange	200.97
Fairfield	1,217.32
Total	$3.595.76
Average cost per acre	.727
Expenses in connection with proposed new work	$15.07

ENTOMOLOGICAL FEATURES OF THE SEASON.

The winter of 1918-1919, unlike the preceding, was unusually mild. There was little snow and the temperature was seldom below zero. Honey bees and native bees which winter-killed severely in 1917-1918, came through the winter nicely and scarcely needed the protection which most of the beekeepers gave their colonies on account of the losses the preceding winter.

The planting season opened late and cold, and plant development and consequently insect development was some two weeks behind that of normal seasons. During June the rainfall was somewhat below normal, but from the middle of July until the end of October, heavy and frequent rains kept the soil soaked with water and many crops needed sunlight. The total rainfall for the season was about six inches more than normal.

Orchard aphids caused considerable injury throughout the state.

Canker worms were present in some localities, but the tent caterpillar was scarce, only a few nests being observed.

The white-marked tussock moth was present, but this and other tussock moths were much less abundant than in 1918.

The potato flea-beetle was abundant and caused considerable damage as in 1918.

The potato aphid was present in small and in moderate numbers on potato and tomato plants, but it did not seem to cause much injury and most owners did not spray to control it.

Aphids attacked peas and injured them considerably. The turnip aphis was also present and injured many small turnip plantings.

The elm leaf beetle was present in injurious numbers and in several towns the trees were sprayed where this practice has been abandoned for several years.

Two of the most conspicuous entomological features of the season were the severe attack on beans everywhere by the green clover worm, and the unusual prevalence of corn borers and other insects attacking corn.

A native borer *Pyrausta ainsliei* Hein., which we may call the smartweed borer, was found in corn stalks in Milford in March, and was thought to be the European corn borer, until the adults were reared in July when it was identified. The stalk borer was very abundant especially in corn and was present in all parts of the state and caused considerable injury.

Crambus praefectellus Zinck. attacked and ruined a small field of corn in New Haven, this being the first instance on record of any real damage being caused by this insect.

The corn ear-worm was responsible for a moderate amount of injury to corn. Specimens were received from various parts of the state, and it was observed in many other localities.

A search was made for larvae and injury of the oriental peach moth *Laspeyresia molesta* Busck, in Stamford where it was found in 1918, but no trace of it was discovered.

The brown-tail moth, though slightly more abundant than in 1918, is still scarce.

The gipsy moth has been well held in check. The number of infestations is now less than half that of a year ago, and if there is no wind-spread the coming spring, it is expected that the number of infestations will again be materially reduced.

On account of the excessive rainfall, it was difficult to prevent the breeding of mosquitoes, and there were some complaints, even where the salt marshes have been ditched. The rain barrel or house mosquito was particularly troublesome and had a chance to breed in pools and receptacles everywhere, as the constant rains prevented these breeding places from becoming dry.

MISCELLANEOUS INSECT NOTES.

Enchenopa binotata Say, Reported as Injuring Beans:—On July 16, specimens of this peculiar bug were received for identification from Stamford, where it was said to be causing injury to garden beans. This species commonly occurs on "bittersweet" *Celastrus scandens*, and is occasionally found on black locust.

Poultry Food Infested with Mites:—On August 22, a sample of poultry food was received from Winsted, which was thoroughly infested with mites. This mite was identified by Dr. Philip Garman of this department as *Tyroglyphus farinae* Deg., a species often occurring in food products.

A Weevil Breeding in Stems of Pigweed and Ragweed:—Stems of red-root pigweed, *Amarantus retroflexus*, and ragweed, *Ambrosia artemisaefolia*, infested with larvae were collected in

Wethersfield February 7. On June 12 a large number of weevils emerged from the stems and were identified as *Baris scolopacea* Germ.

Borers in Stems of Evening Primrose:—Mr. Walden collected stems of evening primrose, *Œnothera biennis*, in Orange, February 20, which contained in the pith a large number of small yellow larvae. On July 17, a number of small white and brown moths emerged from the stems. These were identified as *Mompha eloisella* Clem.

Plum Curculio in Peaches:—Mr. Zappe gathered some unripe peaches at Sound Beach, Stamford, on June 23, which were infested by small larvae. Several infested fruits were also received from Mr. Stancliff Hale, South Glastonbury, on June 16. Adults of the plum curculio, *Conotrachelus nenuphar* Herbst, emerged July 23 from the Glastonbury material.

Leopard Moth in Hartford:—On July 9, a girdled and broken elm branch was received from the Superintendent of trees in the city of Hartford. Without question this was the work of the leopard moth, *Zeuzera pyrina* Linn., which though common enough along the coast has never before been found so far inland in Connecticut, or I think elsewhere in this country.

The Potato Aphid:—So much damage was caused in 1918 by the potato aphid, *Macrosiphum solanifolii* Ashm., that we expected recurring injury in 1919. The species could be found in small numbers in many fields, of potatoes and tomatoes, but in most cases it was not sufficiently abundant to do much damage, and the writer did not learn of a single case where fields were sprayed on account of it.

The Gladiolus Aphid:—On June 17, some gladiolus corms infested with immature aphids, were received from Bristol. These corms had been stored over winter. One of them was planted in a pot in the insectary and soon began to grow, but the aphids multiplied so rapidly that the plant was soon killed. Plate XXXII, a, shows the appearance of the plant when literally covered with aphids. This is known as the gladiolus aphid, *Aphis gladioli* Felt.

Abundance of the Pea Aphid:—On June 6 and 13, pea vines were brought to the office from the vicinity of New Haven, infested by the pea aphid, *Macrosiphum pisi* Kalt., with the report that this aphid was doing great damage to garden peas. In the large truck fields, no treatment is usually practiced in Connecticut. In the home garden, spraying the vines, especially the under sides of the leaves, with nicotine solution and soap will hold this pest in check. Even a forceful spray of water from the hose will knock them off and many will fail to get back to the leaves. If this is repeated every few days, little harm to the plants will result.

Swarms of White Moths:—For two or three nights about September 19, there were great numbers of large white moths with dotted black markings, around the electric lights in New Haven, and doubtless in other towns and cities of Connecticut. This is called the "chain-dotted geometer," *Cingilia catenaria* Drury, and the larvae feed upon the leaves of sweet fern and bayberry. The larvae were very abundant in 1903, and again in 1919, especially in Windham County, where many sweet fern and bayberry bushes were stripped.

Pink Grasshoppers:—A pink form of one of the so-called angular winged grasshoppers or katydids, *Amblycorypha rotundifolia* Scudder, was brought to the Station on August 20, from Orange where it was collected by Mrs. George D. Bathgate. The specimen was a female. On August 12, 1918, a pink female of *Amblycorypha oblongifolia* Deg., was received from New Haven, collected by Miss Molly Hart. On September 21, 1914, two specimens of *Scudderia furcata* Bruner, were received from Derby and a note regarding them was printed in the Report of this Station for 1914, page 187. The adults of these species are normally green, but occasionally the pink forms occur.

Larch Case Bearer:—On August 14, Dr. G. P. Clinton, botanist of this Station, handed the writer some larch twigs which he had collected in Greenwich. The leaves had been mined at the tips by the larvae and had turned brown. There were several of the characteristic cases on the leaves. The insect is an European species known as the larch case bearer, *Coleophora*

laricella Hubner, and it has been recorded from different parts of New England at various times as causing considerable injury. There is only one generation each year, and the adult is a small gray moth which emerges early in June and July. The winter is passed by the larvae which rest in their cases attached to the bark of the twigs. This insect can doubtless be controlled by spraying with arsenate of lead which has been found effective against the closely allied case-bearers on fruit trees.

The Pine Tube-Moth:—While inspecting nursery stock in Hartford in October, Mr. Zappe observed some large white pines growing near the nursery with many of the leaves fastened together to form cases or tubes inside of which the larva feeds. This is the work of the pine tube builder, *Eulia pinatubana* Kearfott. The larva is about one-third of an inch long, pale green with light brown head. The adult is a small moth with a wing-expanse of slightly more than half an inch, and with fore-wings of a dull rust-red color, crossed by two oblique parallel paler bands: rear wings are silky gray. The tube is formed of about fifteen needles fastened together with silk threads as shown on plate XXXII, b. There is probably one brood each season. The insect is not of great economic importance, but if it should prove injurious to choice ornamental trees, spraying with lead arsenate will doubtless be effective in holding it in check.

The Clover Seed Chalcid:—On August 4, Mr. Pelton of the Station Staff brought to the laboratory some seed of a choice hardy variety of clover, which had been procured from Ohio, for seeding in Connecticut. Nearly all of the seeds had a small hole in one side, where some insect had emerged. Many of these seeds were examined and in some were found the dead bodies of a small chalcid fly, which Mr. Walden identified as the clover seed chalcid *Bruchophagus funebris* How. The eggs are laid on the clover heads in the field, the larvae feed inside the seeds and the adults emerge after the seeds are ripe. This insect occurs wherever clover is grown, and there are three broods each year in Illinois. Early cutting of clover is a remedy. The seeds with exit holes are shown on plate XXX, a.

Swarms of Cotton Moths:—On October 5, on Chapel and other business streets of New Haven, there were large numbers

of brown moths resting with folded wings on the plate glass store windows. They flew around the lights the preceding evening and in a few days had all disappeared. Specimens were received from Bridgeport, and Dr. Felt informed the writer that swarms appeared in various sections of New York state at about the same time. This is the cotton moth, *Alabama (Aletia) argillacea* Hubner, which occurs in great numbers in the cotton belt of the southern states, and migrates northward in the fall. Occasionally the swarms reach Connecticut before they are dissipated. Such a swarm appeared in New Haven in 1911, and was mentioned in the Report of this Station for that year, page 339.

Elm Leaf Beetle Again Abundant:—This insect was formerly very destructive to elm trees in southern Connecticut, but for the past few years has not been much in evidence as a pest. Beginning in 1917, it has increased each year and did enough damage in 1918, so that some communities decided to spray their trees in 1919. Trees were sprayed in West Haven and in Clinton, which were not sprayed the preceding year. Possibly the moist weather during the latter part of July and afterward may have induced the growth of the fungus which attacks the pupae, but it came rather late in the season for the best results, and all communities where trees are menaced should prepare to spray the foliage in 1920.

Beans Injured by Gray Hair-Streak Butterfly:—Green slug-like larvae were received from two correspondents in Hartford, on September 15 and 22, respectively, in both cases reported as feeding upon Lima beans. These are the larvae of one of our small butterflies called the gray hair-streak, *Uranotes melinus* Hubner. As a rule, this is not considered a pest in Connecticut, but further south the species is regarded as a minor pest of beans and peas. The butterfly has a wing-spread of one and one-fourth inches, and the wings are blackish with blue-gray tints. Near the tips of the rear wings is a row of bluish spots, with a large orange spot in the center surrounding a small black one, and the rings terminate in slender tail-like processes. There are two broods each year in the north and three in the South. Wherever abundant, this insect may be kept in check by spraying with lead arsenate.

The White Blotch Oak Leaf-Miner:—Several complaints were received regarding an insect attacking the leaves of white oak trees, especially in the central portion of the state, and specimens were received from Cromwell and New Haven. Some of the leaves had been crumpled and possibly attacked by more than one insect, but the samples submitted all showed the presence of the white blotch oak leaf-miner, *Lithocolletis hamadryadella* Clemens. This insect makes a whitish blotch-like mine on the upper surface of the leaf, and attacks different kinds of oaks. The larva is very small, flat, and without feet, and brownish yellow in color. It transforms within the mine, and the adult is a small silvery white moth with a wing-expanse of about a quarter of an inch. There are said to be five or six annual broods in the vicinity of Washington, D. C. There is no method of control known, except to gather and destroy the infested leaves.

Swarms of Aphids:—On June 23, the writer's attention was called to the swarms of green winged aphids which had for a few days been present on Chapel Street and in other parts of the city. The tops of automobiles and the clothes of persons were literally covered. There were many inquiries at a local seed store, and some persons thought they were seventeen-year locusts. One of the Station employees stated that when riding his bicycle into New Haven on Dixwell Avenue, his clothes were fairly covered with these aphids. Assistants were sent to Chapel Street to collect specimens, and found them to be aphids with heavily-marked wing-veins. Some were mounted on microscope slides and sent to Dr. Edith M. Patch, Agricultural Experiment Station, Orono, Me., who identified the species as *Calaphis betulaecolens* Fitch. This aphid feeds upon birch, is supposed to remain on its host throughout the season, and was extraordinarily abundant all over Connecticut in 1919. Of course there are few birches in the city, but there are many acres of gray or bobbin birches, *Betula populifolia,* in Orange only three or four miles from the center of New Haven, and with the prevailing winds blowing from the southwest, this section was probably their source. Possibly they became so abundant that they were obliged to leave their hosts in search of food. There were a number of newspaper accounts of the incident, some being more startling than accurate.

Flea Beetle on Swiss Chard:—On June 28, one larva feeding on swiss chard was received from Salisbury, with the statement that the insect was causing considerable injury in gardens in that vicinity. The larva was about a quarter of an inch long, and covered with black spines which are white at the tips. An adult emerged July 21, and proved to be the spinach flea beetle, *Disonycha xanthomelaena* Dalman. It feeds upon pigweed, beet, swiss chard and spinach, the larvae occurring on the under side of the leaves. When young the larvae feed in clusters, but separate when they are partly grown. They often drop to the ground when disturbed. At first they eat only the epidermal layer, but later eat holes through the leaves. The adult is about one-fifth of an inch long, greenish black with yellow prothorax, and hibernates as an adult. In the vicinity of Washington, D. C., there are two broods annually.

Of course it is not safe to apply poison to any foliage which is to be used for food. Therefore on swiss chard and spinach, it may be possible to spray the under surface with strong soap and water, or to brush the plants just before cultivating. The adults can be caught like the flea beetles by passing over the rows a box lined with tanglefoot.

An Outbreak of Book Lice in a House at Milford:—On August 6th, a telephone communication was received at the Station from Milford regarding some very small insects infesting a dwelling house, and from the description, the identity of the insect could not be established. Therefore the writer was sent to investigate. The insect found proved to be a species of book louse, *Atropos pulsatoria* Linn., belonging to the order Corrodentia. The individuals were numerous, being present in all parts of the house, in the cracks of the floors, on the stairs, under rugs, behind pictures, and some were also found on the furniture.

The owner of the house thought that the pest might have been brought into the house on baskets of eggs from the hen houses, which on examination were found also infested.

The injury caused by the insects was more imaginary than real; the housewife was worried because she did not know what the insects were, or how to get rid of them. The only place where they seemed to be doing any damage was on the under side of the

dining room chairs. The chair seats were made of strips glued together, and many book lice were present on the under side, together with some very fine white dust, which the members of the family declared was not there when the chairs were purchased a short time before. There is still some doubt whether the book lice were responsible or whether the wood was powder posted before or soon after being made into chairs.

The treatment advised for the control of this insect was to wash floors and woodwork with hot water and soap and to wipe over the furniture and pictures, etc. with the same. The house was again visited on December 1, and the family reported that the book lice had then all disappeared, but that they were present until the cold weather set in, and probably were not all killed by the treatment. It is probable that the insects may appear again in the spring, and if so, the house will be fumigated with hydrocyanic acid gas.—M. P. Zappe.

A Tobacco Warehouse Infested by the Cigarette Beetle:— On December 31, 1918, there was brought to the Station a handful of choice shade-grown wrapper-leaf tobacco infested with larvae and adults of the cigarette beetle, *Lasioderma serricorne* Fabr. This tobacco came from a large tobacco storehouse, where on the fourth floor several hundred bales of the 1917 crop were stored. The writer visited this storehouse on January 2nd, 1919. Some bales were rather badly infested around the edges and butts.

A local contractor had tried to kill the insects by fumigating with carbon disulphide, first by fumigating the whole room (which was a failure) and, second, by putting a dose on the top end or side of each opened bale. The second method killed some of the insects but did not penetrate sufficiently to prove effective, and those inside were alive after the treatment. Moreover, there was the disagreeable odor of the carbon disulphide discernible in several of the bales, and there was some apprehension that it might affect seriously the quality of the tobacco, which would obviously be ruined for wrapper purposes if the insects were not killed promptly. The storage room was said to contain 93,000 cubic feet.

After a general survey of the situation, I advised heat as the most practical method of treatment. A sweating room opening

out of the large storeroom was at a temperature of 96° F. at the time of my visit. Only two pipes had steam in them and ten more were available. Additional steam coils could be installed if needed to bring the temperature up to the required point.

On January 10th, I made another visit to the warehouse. The heat had been given a trial. Additional pipes were added and the temperature was raised to 148° F. The tobacco bales were placed in the room January 8th and left there over night: they were stacked flatwise with 2 x 4 inch scantling between them to allow for circulation. A thermometer placed inside one of the bales registered 130° F.

Though most of the insects had apparently been killed, there were a few still alive, and one of the owners seemed to regard the treatment as a failure. Considerable material was gathered and brought to the laboratory and examined with the following results:—

	Dead	Living
Larvae	273	7
Pupae	3	0
Adults	62	0
Total	338	7

These figures show that 2.56 per cent. of the larvae, or 2.1 per cent. of all stages came through alive. In spite of the fact that some were not killed, this seemed to me by far the best possible method of treatment, and it is probable that if the temperature could have been kept for a few hours longer to allow the bales of tobacco to become thoroughly heated through, it would have killed all the insects. A communication to this effect was sent to the owners, who later were asked about the matter and replied as follows:—"Our treatment to rid ourselves of the cigarette beetle consisted in putting the entire tobacco in one of our sweatrooms and running the heat up to 130° F. At this temperature we left the tobacco in the room for five hours. A day or two later we took all of the packages out of the sweat-room and put them in a building without heat. It so happened that the days following were extremely cold. We have examined any number of the packages from time to time and have found no trace of living beetles or larvae. The bulk of the tobacco has been shipped to the various customers and we have not had a single complaint regarding it."

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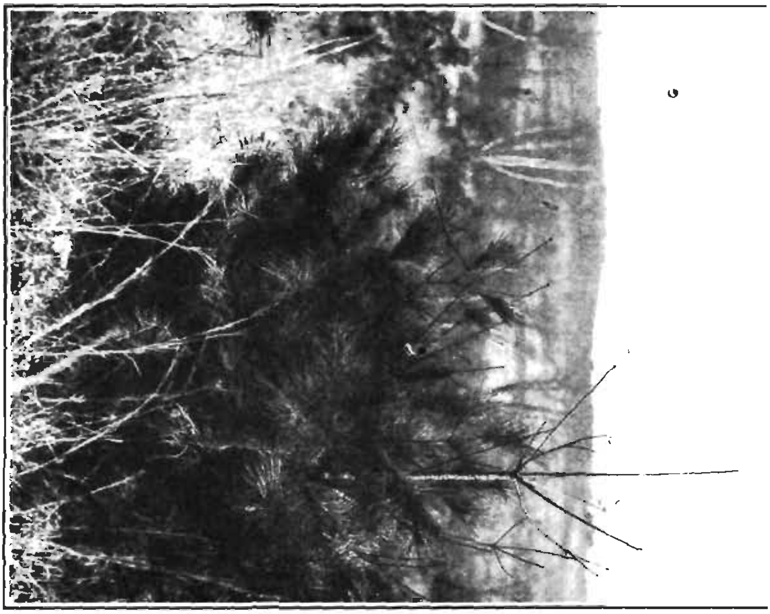
All plates are from photographs from the following sources:—Plates IX, a, X, b, and the right half of Plate XVI, by W. O. Filley; Plate XI, a and b, by Professor Samuel J. Record; Plate XIII, c, by Harry A. Doty; left half of Plate XVI, by D. B. Pangburn; Plate XIII, b, by Harry B. Kirk; Plates XIV, b, XVIII, a, XIX, b, XX, a, by W. E. Britton; Plates XVIII, b, XXI, a, XXII, b, XXIII, a, XXIV, a, XXV, a, c and d, XXVII, a and c, XXIX, a, b and c, XXX, a and c, by K. F. Chamberlain. All others by B. H. Walden. The text figures are from drawings as follows:—Figure 16 prepared from map by Mr. Walden; figures 17 and 18 by A. B. Champlain; figure 19 by Dr. Philip Garman. Figure 20 from Bureau of Entomology, U. S. Department of Agriculture.

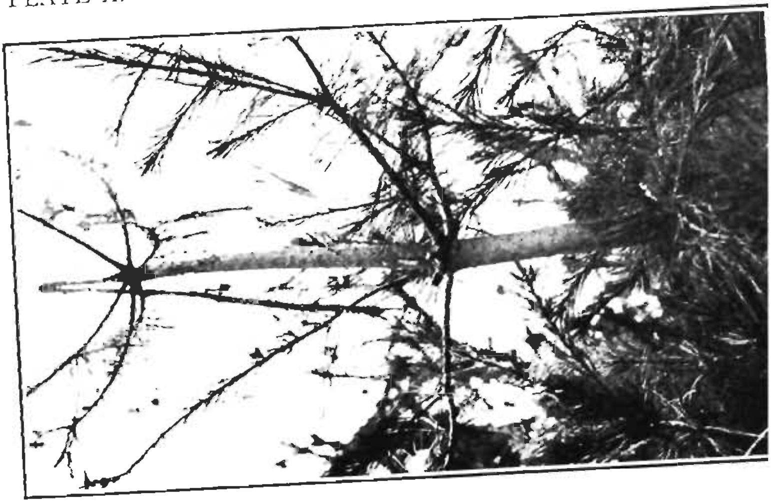
a. Young white pine tree with leader killed by weevil.



b. Young pine tree with leader and some of the lateral branches killed by weevil.

WHITE PINE WEEVIL.

PLATE X.

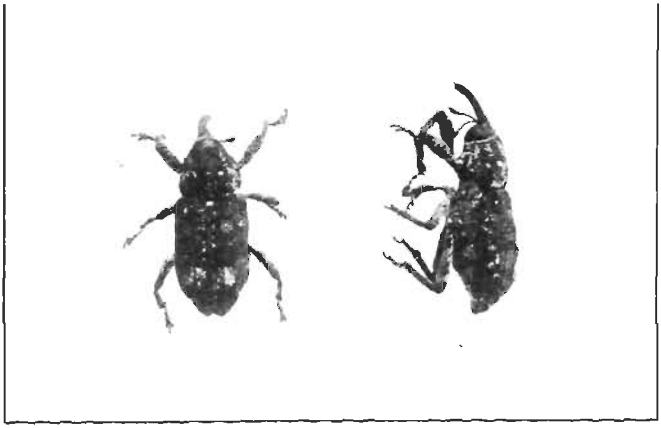


WHITE PINE WEEVIL.

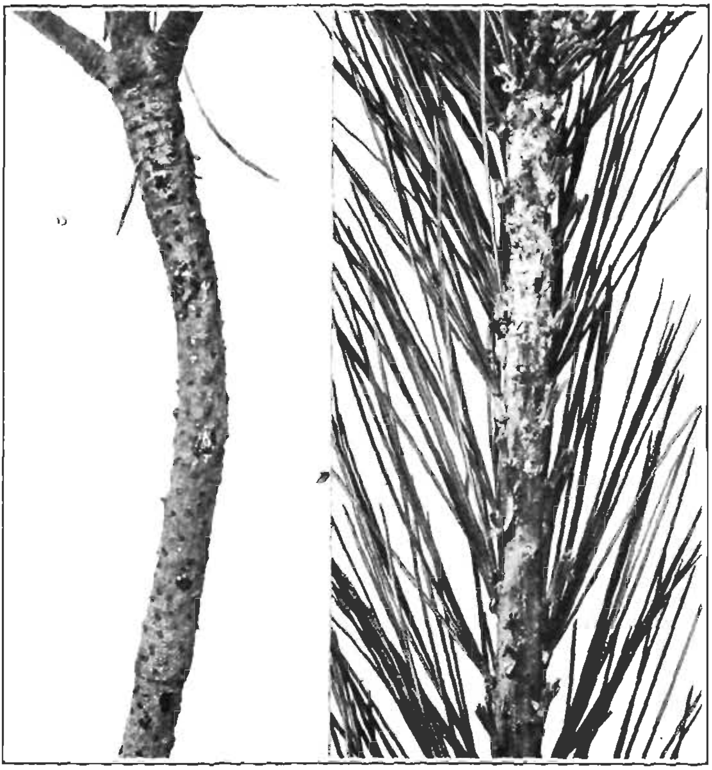
a. All laterals removed except this one, to induce a stronger growth.

b. A forked tree resulting from the loss of the leader by weevil injury.

WHITE PINE WEEVIL.

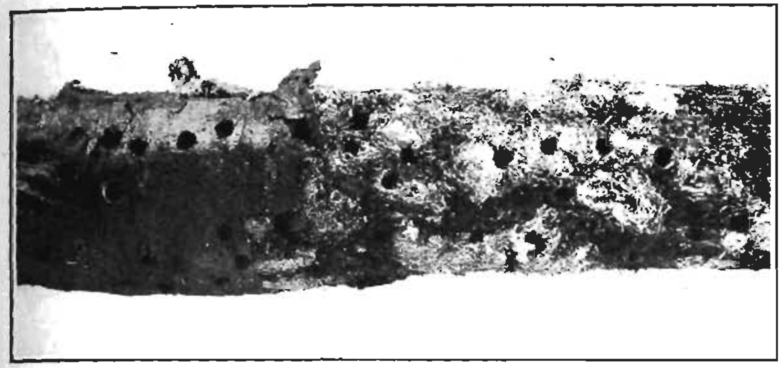


a. The white pine weevil. Adult beetles, four times enlarged.

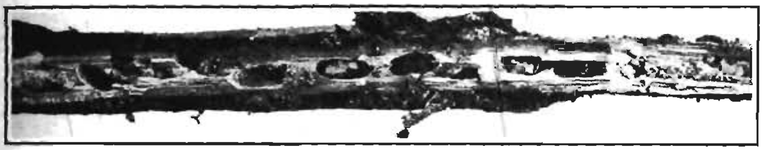


b. Weevil punctures and resin exudation from them. Natural size.

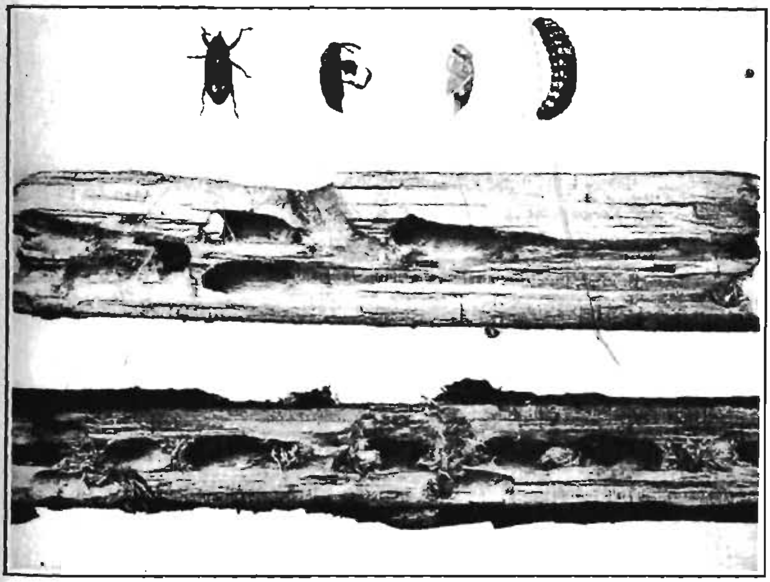
WHITE PINE WEEVIL.



a. Exit holes of white pine weevil. Natural size.



b. Larval cells in pine leader. Natural size.

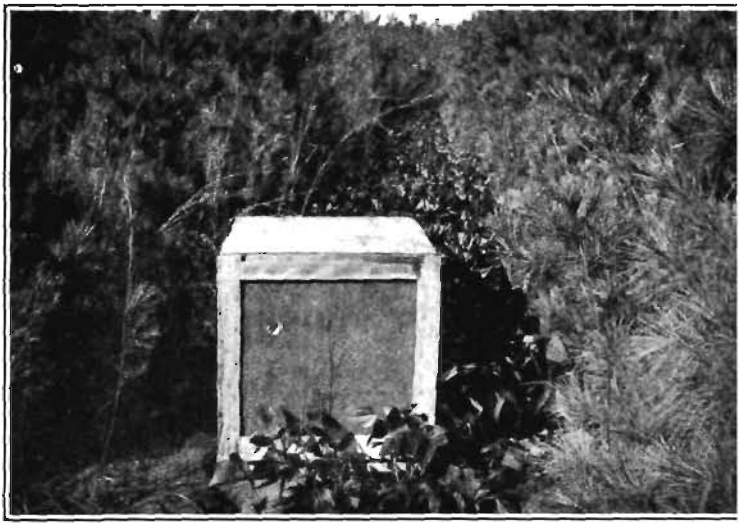


c. Adults, larva, pupa and cells in pine leader. Slightly enlarged.

WHITE PINE WEEVIL.

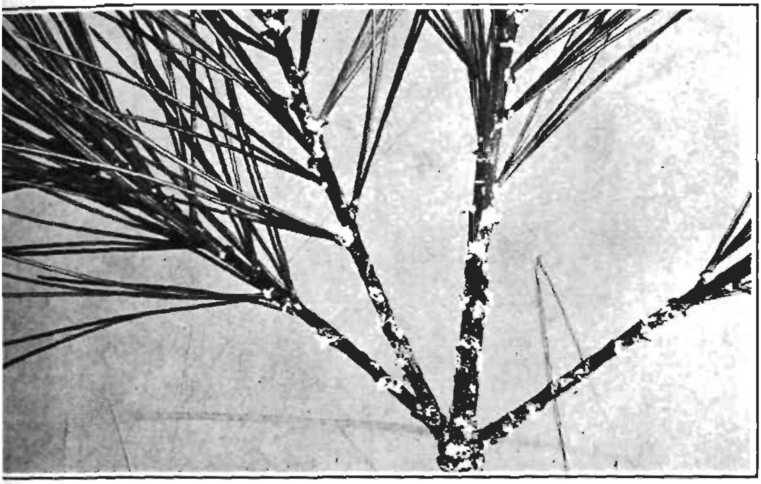
PLATE XIV.

a. Method of collecting weevils in white pine plantations.

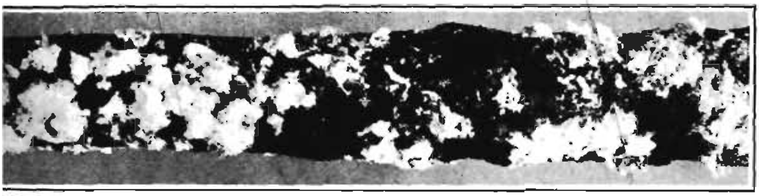


b. Box to hold cut leaders. Wire screen allows parasites to escape bu weevils are imprisoned.

WHITE PINE WEEVIL.



a. The pine bark aphid in small tufts on twigs and leaves. Natural size.

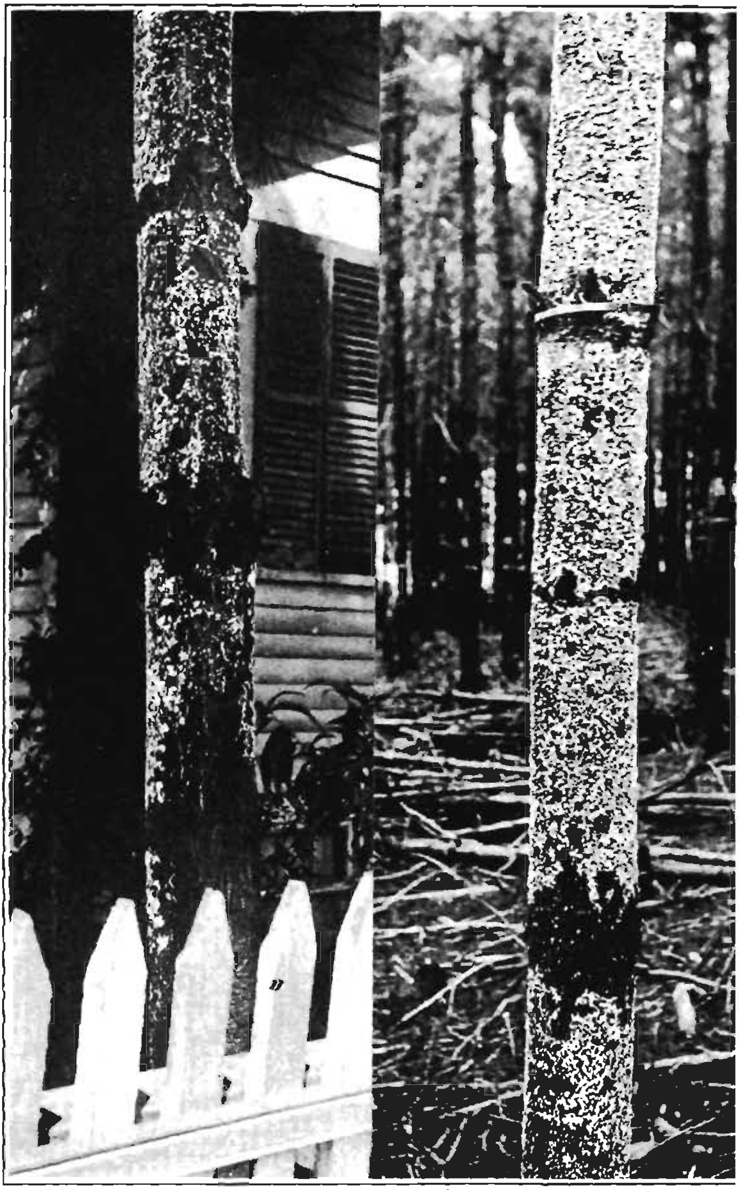


b. Pine bark aphids in larger tufts on twig. Natural size.

c. Method of hand spraying pine trees.

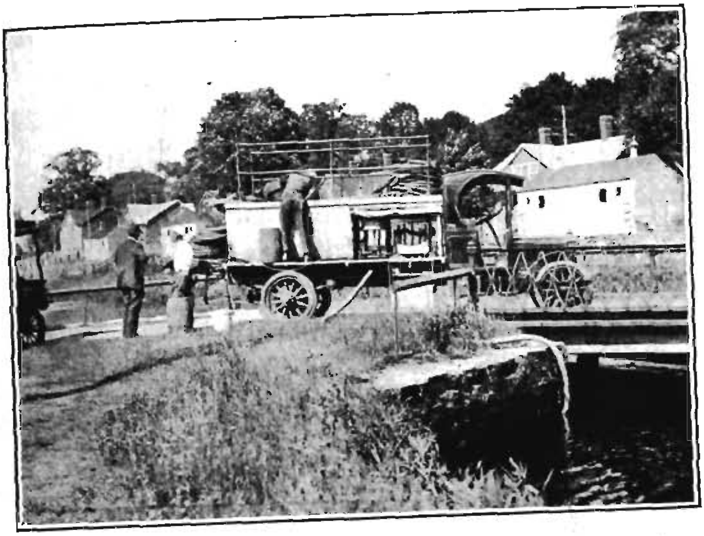
PINE BARK APHID.

PLATE XVI.



The pine bark aphid on trunks of trees.

PINE BARK APHID.



a. Automobile truck power sprayer taking water from canal.

b. Spraying woodland trees with automobile truck power sprayer.

GIPSY MOTH WORK.

PLATE XVIII.

a. Underspraying beans with nicotine solution and soap.

b. Patch of beans in a garden showing injury by the caterpillars.

GREEN CLOVER WORM.

a. Larvae feeding upon bean. Natural size.

b. Larva and pupa. More than twice natural size.

c. Adult moths. Twice natural size.

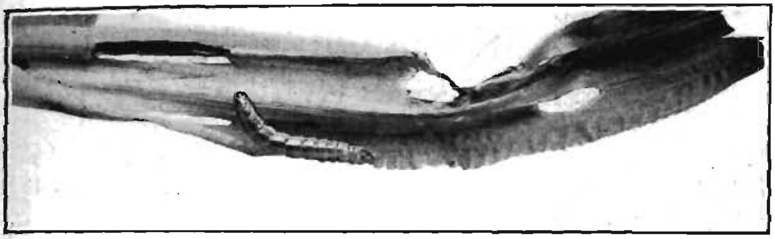
GREEN CLOVER WORM.

PLATE XX.

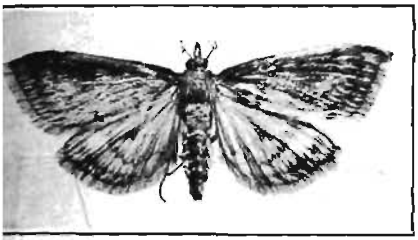
a. Cornfield in Milford, first found infested with larvae.

b. Second field found infested. This is a short distance north and across the street from the field shown above.

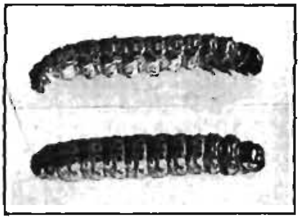
A NATIVE CORN BORER, PYRAUSTA AINSLIEI.



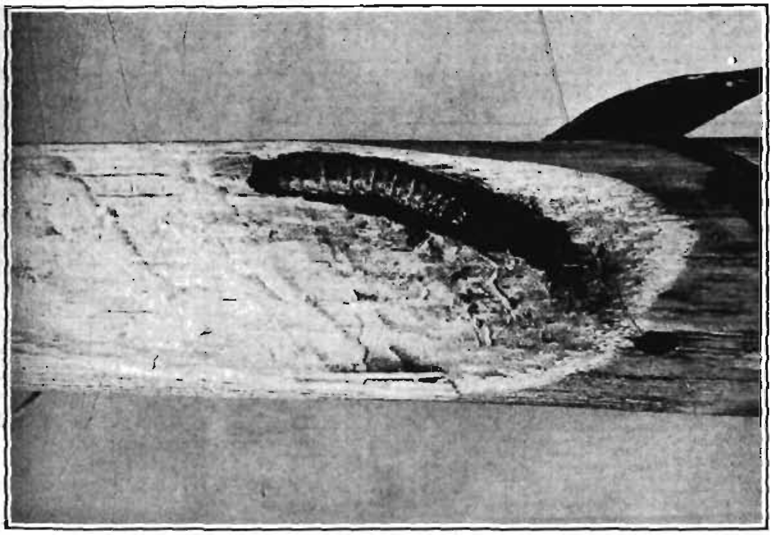
a. The lined corn borer, *Hadena fractilinea*. Larva, natural size.



Pyrausta ainsliei Hein. Adult twice enlarged.

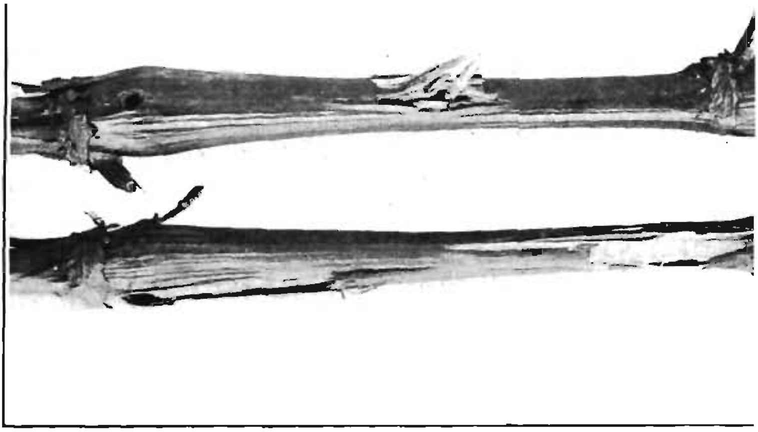


c. *Pyrausta ainsliei*, lateral and dorsal view of larva. Twice enlarged.

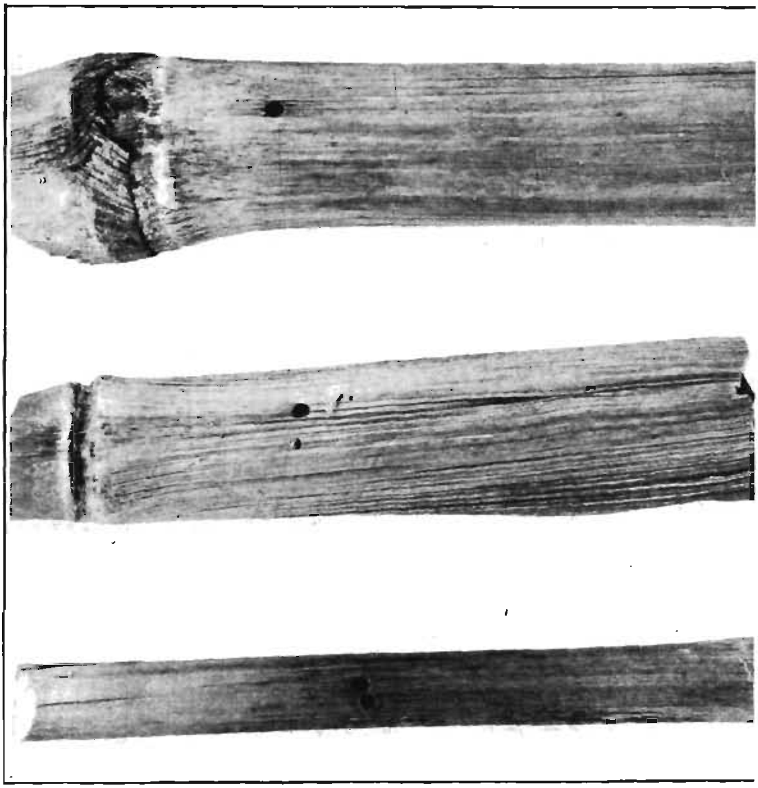


d. Larva of *Pyrausta ainsliei* in burrow in cornstalk. Twice enlarged.

THE LINED CORN BORER, HADENA FRACTILINEA.
A NATIVE CORN BORER, PYRAUSTA AINSLIEI.

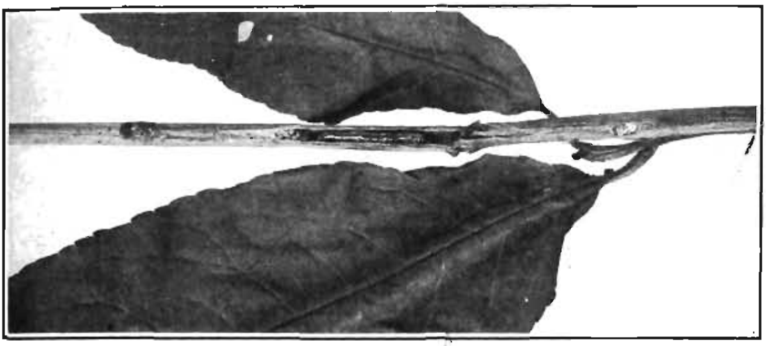


a. Burrows in smartweed, torn open by birds to get at the larvae. Natural size.

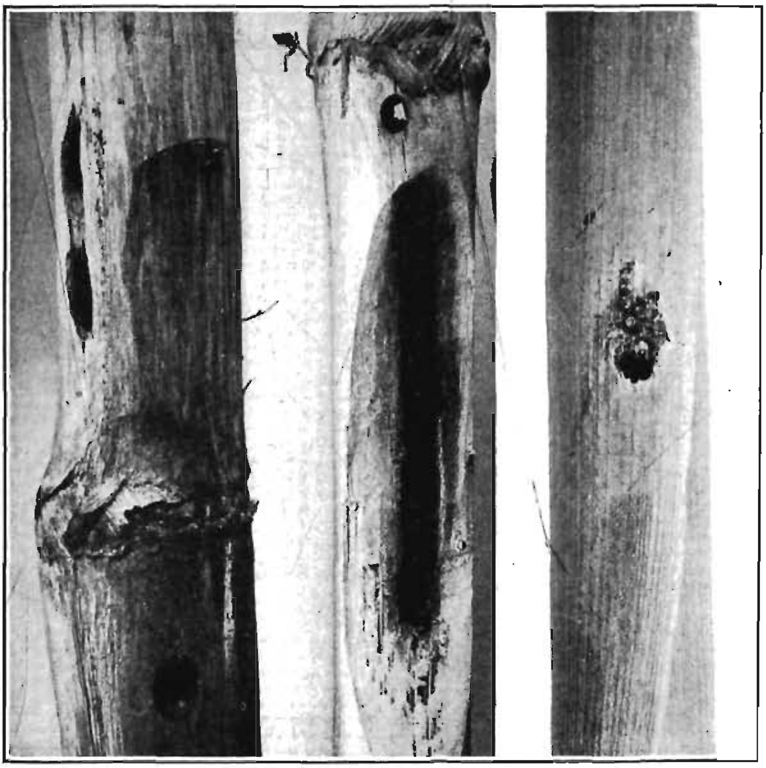


b. Entrance holes in corn stalks. Natural size.

A NATIVE CORN BORER, PYRAUSTA AINSLIEI.

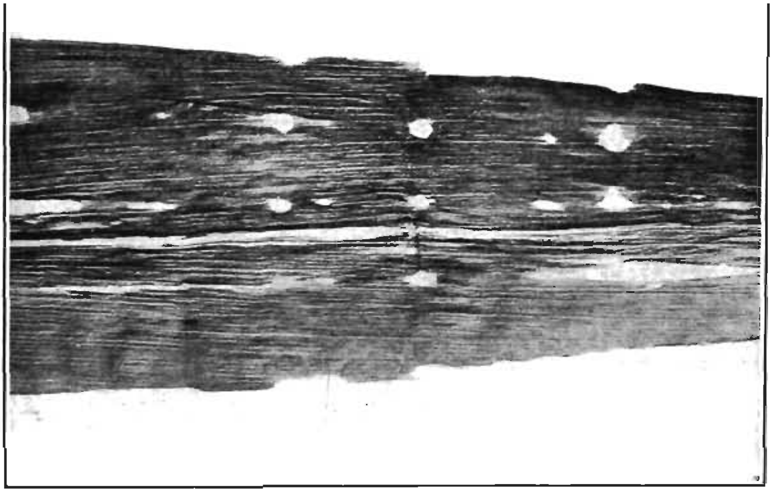


a. Larva in peach shoot growing near ground. Natural size.

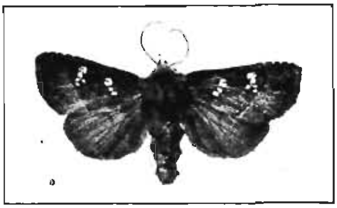


b. Burrows in corn stalks. Natural size.

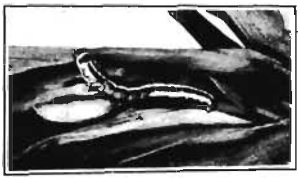
THE STALK BORER.



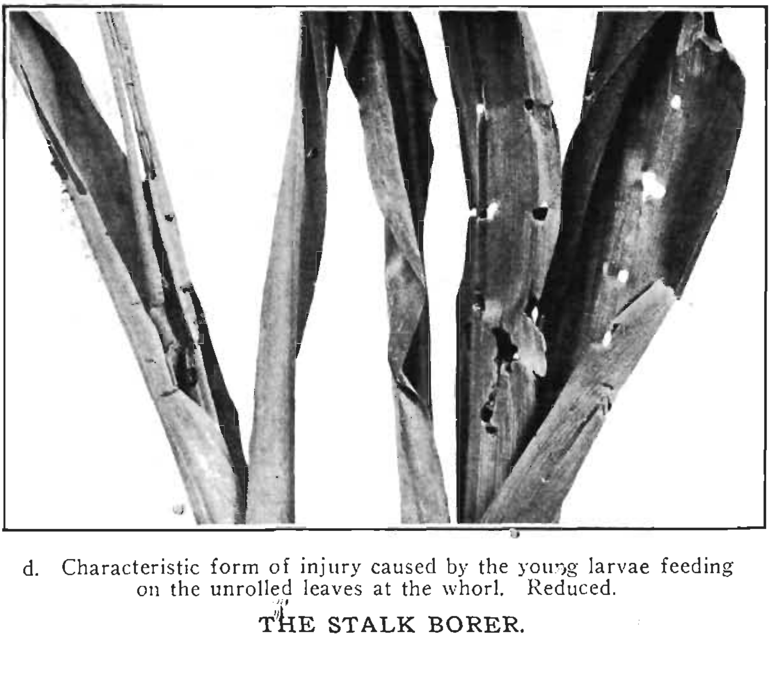
a. Characteristic injury near tip of blade. Holes eaten by larva before leaf unrolled. Natural size.



b. Adult of stalk borer. Natural size.



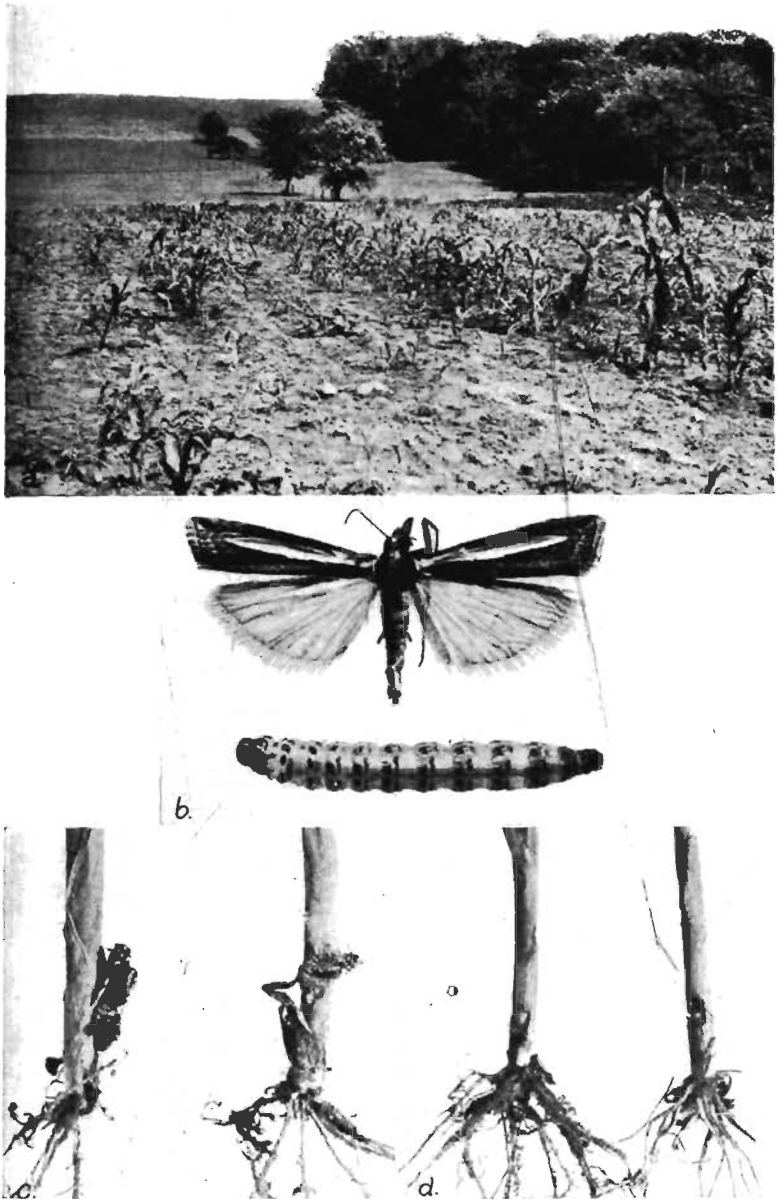
c. Immature stalk borer in corn. Natural size.



d. Characteristic form of injury caused by the young larvae feeding on the unrolled leaves at the whorl. Reduced.

THE STALK BORER.

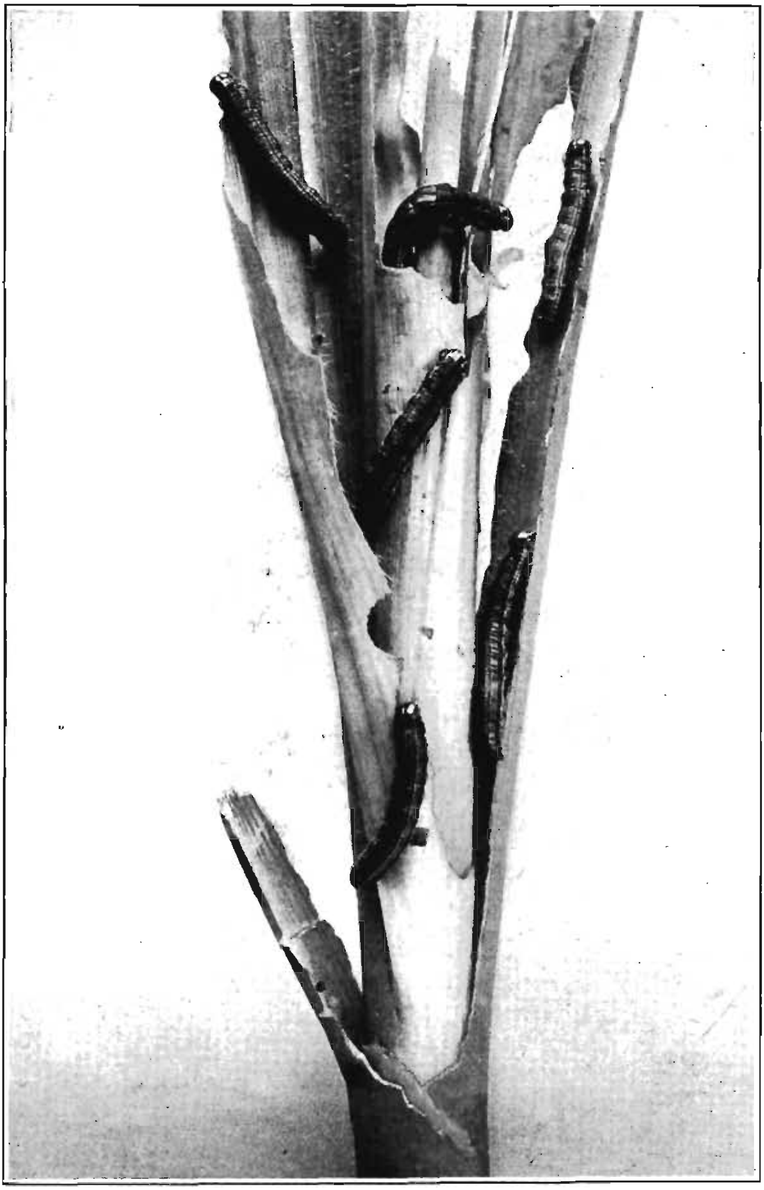
PLATE XXV.



a. Cornfield ruined by the attacks of the larvae.
b. Larva and adult. Four times enlarged.
c. Larval cases on base of stalks. Reduced.
d. Injury to stalks, cases removed. Reduced.

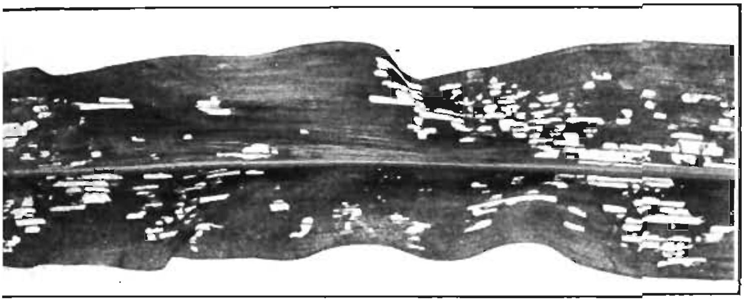
CRAMBUS PRAEFECTELLUS.

PLATE XXVI.

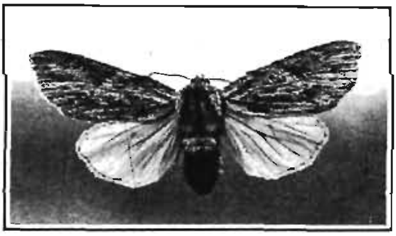


Larvae feeding on corn. Natural size.

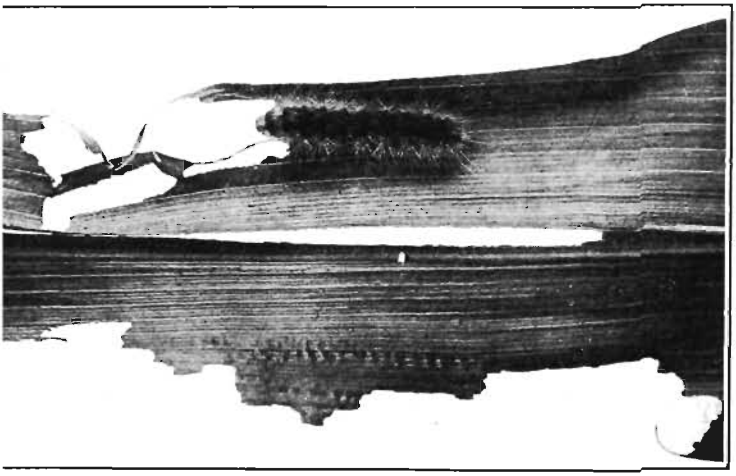
THE ARMY WORM.



a. Work of young larvae on corn blade. Much reduced.



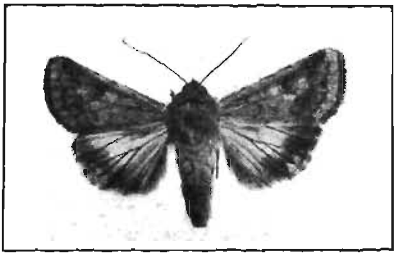
b. Adult moth. Natural size.



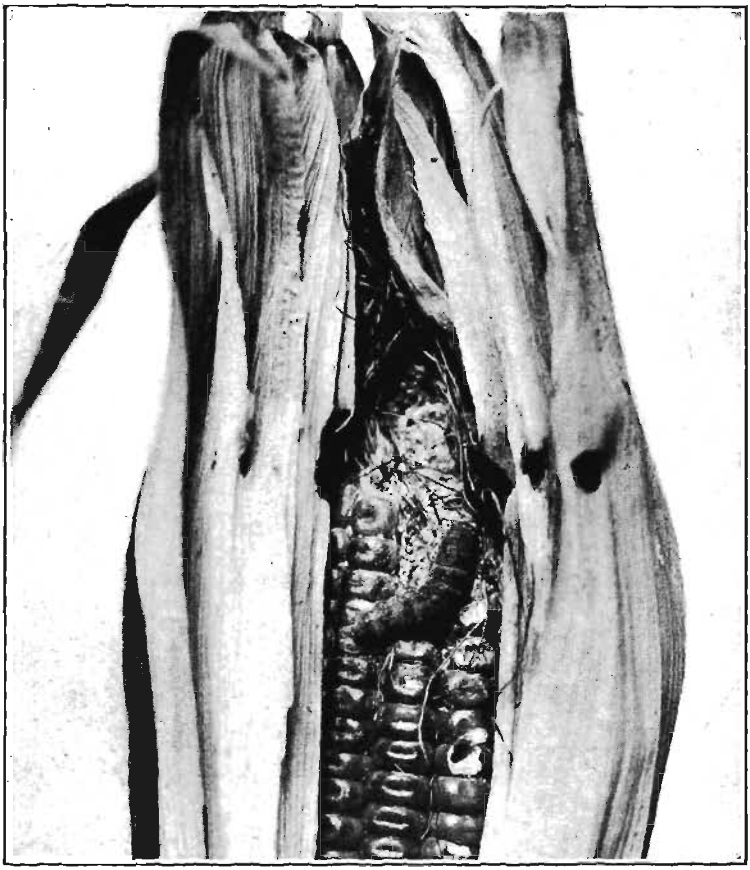
c. Partially grown larva feeding upon corn leaf. Natural size.

THE SMEARED DAGGER MOTH.

PLATE XXVIII.

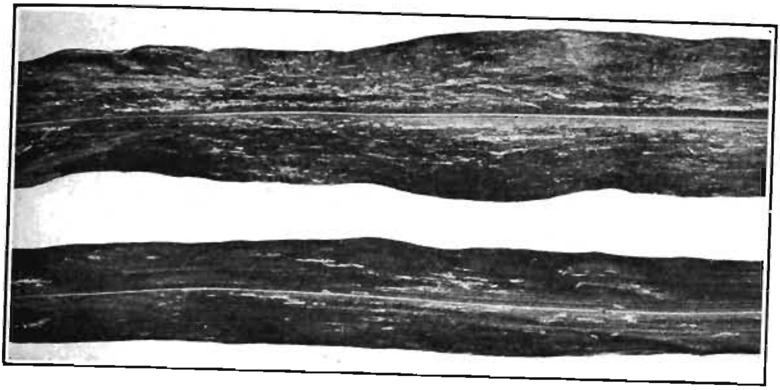


a. Adult moth. Natural size.

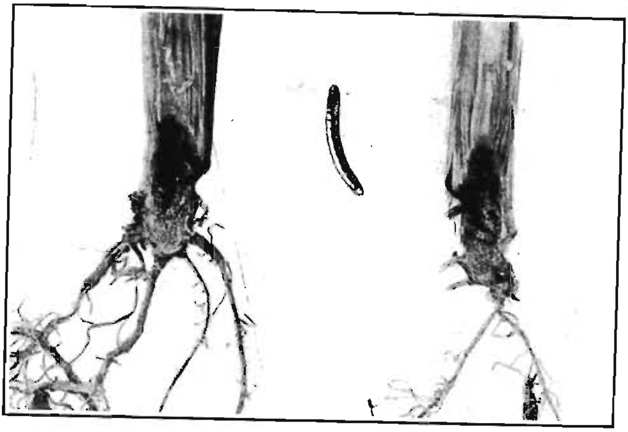


b. Larva feeding at tip of ear of corn. Natural size.

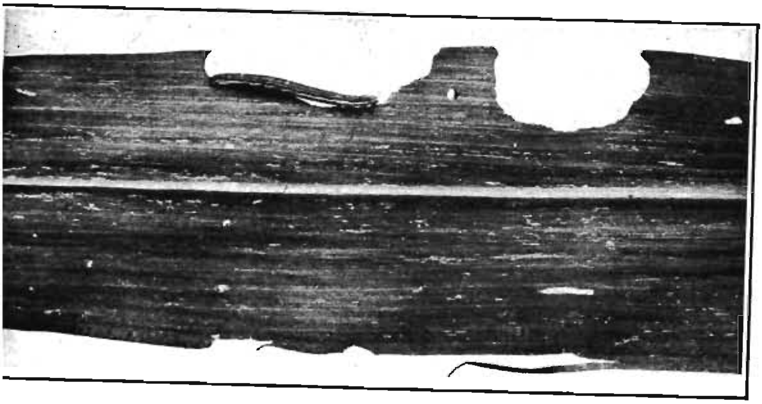
CORN EAR WORM.



a. Injury to leaves by the grass thrips. Much reduced.



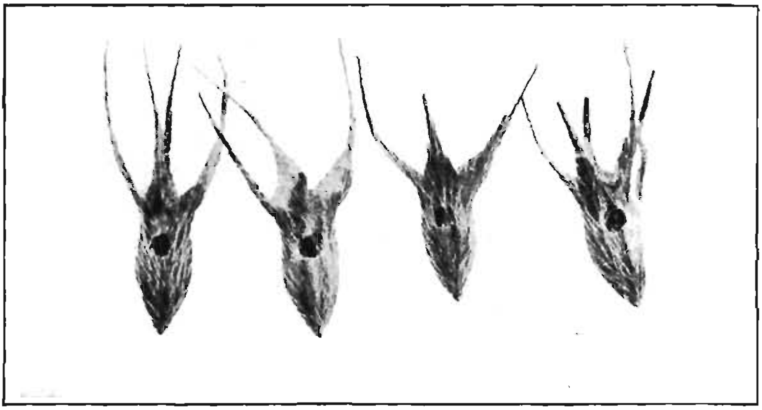
b. Injury by wire worms. Natural size.



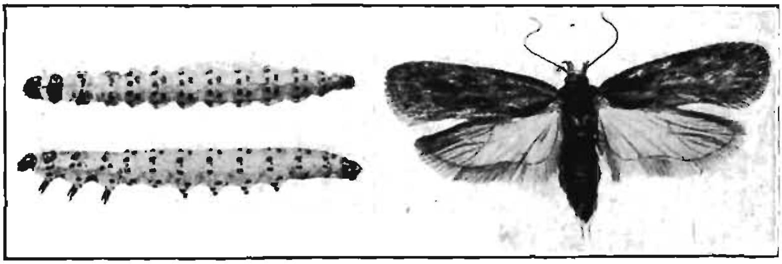
A slender green larva feeding upon corn. Unidentified. Natural size.

CORN INSECTS.

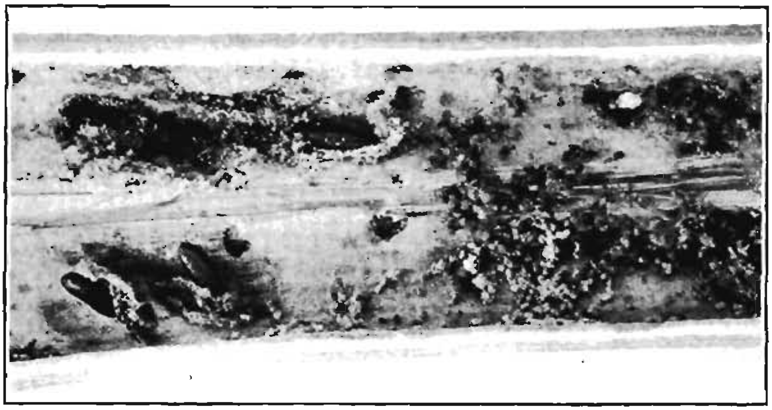
PLATE XXX.



a. Clover seeds showing exit holes of the clover seed chalcid. Four times enlarged.

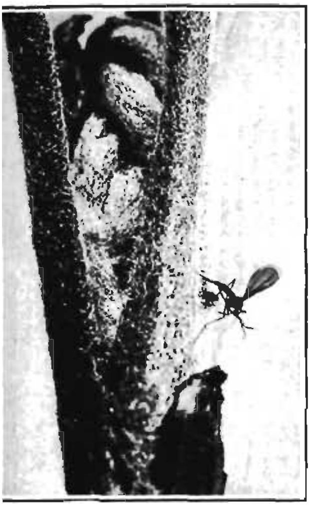


b. Lateral and dorsal view of larva, and adult of parsnip web worm. Twice natural size.



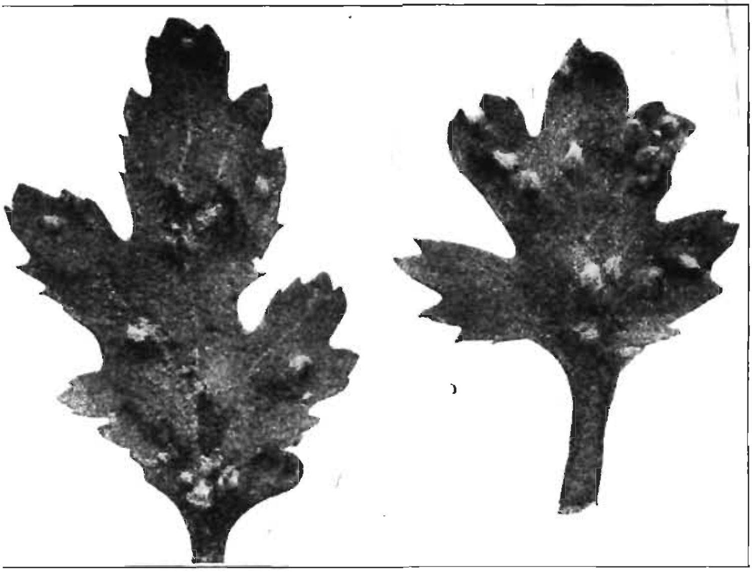
c. *Inside of stalk of cow parsnip showing pupae of parsnip web worm.* Natural size.

CLOVER SEED CHALCID AND PARSNIP WEB WORM.



a. Adult fly laying eggs. Three times enlarged.

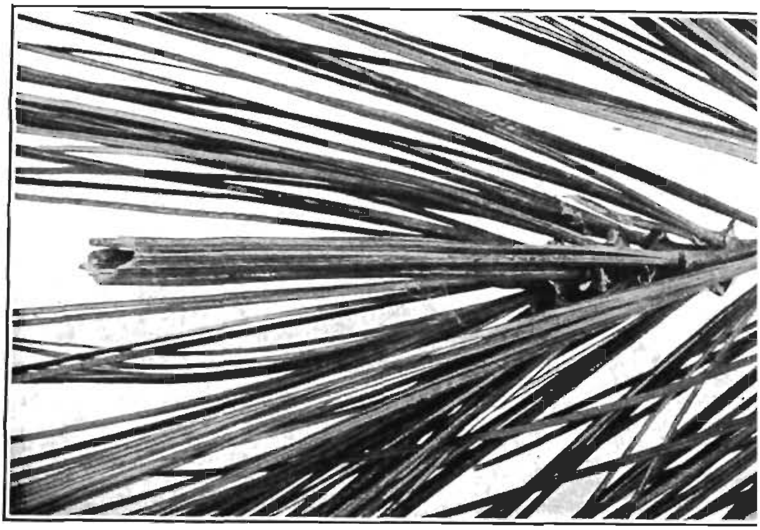
b. Galls on new shoot. Twice enlarged.

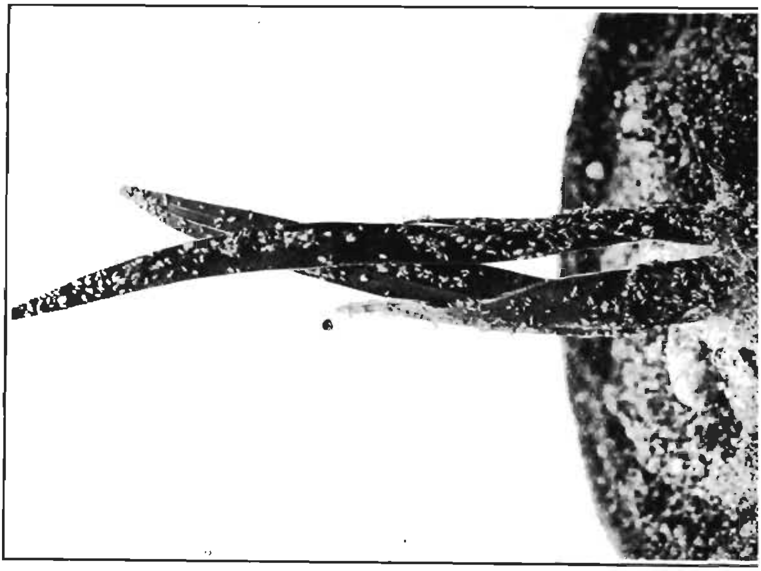


c. Galls on chrysanthemum leaves caused by the chrysanthemum gall midge. Twice natural size.

CHRYSANTHEMUM GALL MIDGE.

PLATE XXXII.





PINE TUBE BUILDER AND GLADIOLUS APHID.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 219 DECEMBER, 1919

BEING THE

Twenty-Fourth Report

ON

Food Products

AND

Twelfth Report on Drug Products.

PART I.

By E. M. BAILEY.

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the editions permit

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The Twenty-fourth Report on Food Products and the Twelfth Report on Drug Products, 1919.

PART I.

BY E M. BAILEY.

The work here discussed and summarized comprises the results of food and drug inspection during the past year. Practically all of this work is called for by statute requirement. In addition, however, it is our aim and purpose to do, each year, something of an investigative nature which shall be of interest and value and which is outside of the immediate field of police duty. In harmony with this idea considerable attention has been given during the past year to a resurvey of the diabetic food market and approximately one hundred diabetic preparations have been examined. These are chiefly commercial products, but include also several types of preparations of direct interest and application in the treatment of diabetic patients. The results of this investigation will be published later as Part II of this report.

Of chief interest in control work has been the inspection of ice cream carried on under the act pertaining to the manufacture and sale of ice cream which was passed by the last Legislature.

At the Farmers' Week Fair held in Hartford in January 1919 the food work done by this Station was represented by an exhibit made by this laboratory.

The chemist in charge has been called upon during the year for attendance at legislative and other hearings in connection with proposed food laws on the administration of those now in force; he has continued to act as expert on diabetic foods for the American Medical Association, also as A. O. A. C. referee on tea; and, by appointment of the Governor dated August 4th, 1919, as a state chemist.

The resignation of Mr. Street, formerly chemist in charge, and of Messrs. Morison and D'Esopo will be duly noted in the annual report of this Station. To them and to the remaining members of the staff acknowledgment is made of their contributions to the work herein reported.

I. FOODS.

ICE CREAM.

Legislation. Chapter 260 of the Public Acts of 1919 concerning the manufacture and sale of ice cream fixes the standard for milk fat in plain ice cream at not less than eight per cent.; and in fruit and nut ice creams at not less than six per cent. The act prohibits in the manufacture of this product the use of boric acid, salicylic acid, formaldehyde, saccharin or any substance deleterious to health, or any coloring matters deleterious to health; but the use of harmless colors permitted to be used in foods, and harmless imitation flavors is allowed, provided that the presence of the same is declared.

Preliminary Inspection. A preliminary survey of the State was made by the Dairy and Food Commissioner and four hundred and sixty-nine samples were collected from forty-five towns. Two hundred and forty-eight samples were examined in this laboratory and the remainder of the tests were made by inspectors of the Dairy and Food Department who hold licenses to test milk and cream, and who used methods approved by this laboratory.

Of the total number of samples examined one hundred and seventy-three or 36.9 per cent. were found to be below the required standard for ice creams of their respective types.

On the basis of these results the Commissioner held hearings in those cases where deficiencies were found, to call attention to the law now provided, and to suggest, if necessary, ways and methods for meeting its requirements.

It was found that, as might be expected, the larger manufacturers were well informed as to the fat content of the ingredients entering into the mix, but, in the majority of cases, smaller dealers were ignorant both of the fat content of the ingredients composing the mix and of that of the finished product.

The point was also raised that the fat content in ice cream dispensed in bulk from one, three or five gallon cans would show a variable composition according to whether the sample was taken from the top, middle or bottom of the container.

It can readily be understood that ice cream which has softened or "weakened" will lose uniformity of composition. The exten-

sive study of ice cream making carried on at the Vermont Station[1] has shown the possibilities in this direction. It appeared however that the product held for a week in a thoroughly frozen condition showed no difference in fat content in portions taken from the top, middle and bottom zones.

Uniformity of fat distribution in bulk ice cream. Several of the larger ice cream manufacturers in New Haven cooperated by supplying us with ice cream as it would be delivered to the consumer or retailer, in gallon and two and a half gallon lots.

When received the containers were warmed just enough to permit the cream to be removed from the can in a solid mass, and cross sections were taken from the top, middle and bottom zones. The several portions were melted at room temperature, well mixed and tested for fat by the Babcock method as modified by Grigsby.[2]

A. This was a one gallon can of chocolate ice cream thoroughly frozen when received. The tests on the several portions were as follows:

Top	9.1%
Middle	9.1%
Bottom	9.2%

B1. This was a two and one half gallon sample of vanilla cream in a hard condition when received and tested.

B2. This was a two and one half gallon sample of vanilla cream held over night in the container as delivered before tests were made. The cream had softened to such an extent that it could not be removed from the can intact; the middle portion was hard but the top and bottom portions were considerably softened. Tests on the two samples were as follows:

	B1	B2
Top	9.9%	9.6%
Middle	9.6%	9.3%
Bottom	9.4%	9.4%

The results on sample B2 show greater uniformity than would be predicted with the mechanical condition of the sample in mind. The explanation is that the product is homogenized, or

---

[1] Vermont Agr. Exp. Sta., Bull. 155 (1910).

[2] Jour. A. O. A. C., 2, 4, p. 242.

made from homogenized materials, and therefore the stratification of fat is very markedly prevented.

C. This was a one gallon can of vanilla cream. The non-uniformity of the product was apparent as soon as it was removed from the container. Melting the sample representing the top portion at room temperature, a frothy liquid resulted which separated a creamy layer on standing and which it was very difficult to effectively mix either by stirring or pouring. After considerable manipulation a mixture was obtained which was reasonably uniform. The middle and bottom portions were not so troublesome but were sampled with difficulty. The results obtained on the three portions were as follows:

Top	15.2%
Middle	11.5%
Bottom	12.4%

The results show what was quite evident in the beginning, viz., that the product was very ununiform as regards fat distribution. They cannot be accepted as proving that only homogenized products will show uniformity because sample A was not homogenized; but it is no doubt true that homogenized products will remain uniform longer than unhomogenized products. This sample was quite different from any met with either in the preliminary survey or the official inspection, which included twenty or more samples from this same source.

Altogether the results indicate that there is but little variation in fat distribution in ice cream kept in a thoroughly frozen condition. Uneven distribution of fat will result if the cream becomes "weakened," i. e. soft; but this is much less pronounced in homogenized products.

In taking the official samples under the ice cream law the mechanical condition of the cream, i. e. hard, soft, partially melted, etc., should be noted as well as the relative position in the container, i. e. top, middle or bottom, from which the sample was drawn.

Methods of testing ice cream. In testing ice cream the preparation of the sample is of the greatest importance. Samples which had liquified and which had been held for several days gave unsatisfactory tests which were attributed to difficulties in sampling. Creams delivered in a fresh, frozen condition, with

no opportunity to churn were found to yield uniformly satisfactory results. If the cream has separated fat by churning or otherwise, gentle heat must be applied to melt the fat and it must then be evenly mixed by pouring or stirring.

The Roese-Gottlieb method for the determination of fat is regarded as the standard method for such products as condensed milk, ice cream and other milk products, but for rapid work of routine inspection some of the modified Babcock methods are necessarily employed. Besides the Grigsby method already mentioned we have used one described by Lichtenberg[1] with generally satisfactory results. When, occasionally, we have found disagreement in results we have used the Roese-Gottlieb procedure as the deciding test. A few unexplained disagreements have occurred but in case of fresh, well frozen creams, tested promptly, we have found good agreement between the three above mentioned methods.

Official Inspection. Eighty-two samples were collected by agents of the Dairy and Food Commissioner's Department. Arranged on the basis of milk fat content the samples may be classified as follows:

	Samples.	Per cent.
Fat 8 to 9 per cent.	15	18.3
9 to 10 per cent.	10	12.2
10 to 12 per cent.	26	31.7
12 to 14 per cent.	15	18.3
14 to 20 per cent.	13	15.8
below 8 per cent.	3	3.7

The samples showing fat deficiencies were as follows: **16025** Chocolate, Joe Crudo, So. Norwalk, 4.16 per cent.; **15988** Vanilla, Geo. Costeine, Bridgeport, 4.56 per cent.; **15987** Chocolate, Wm. H. Whitney, Bridgeport, 5.70 per cent.

Of eighteen samples sent by individuals only one was found below 8 per cent. of fat.

BAKING POWDER.

The following definition and standard for baking powder has been adopted:

Baking powder is the leavening agent produced by the mixing of an acid reacting material and sodium bicarbonate, with or without starch or flour.

[1] Jour. Ind. Eng. Chem., 5, 9, p. 786 (1913).

TABLE I.—ANALYSES OF

No.	Brand and Manufacturer.	Dealer.
		BRIDGEPORT:
11487	Howco; made for Howland's, Bridgeport	Howlands ....
11481	Gold Seal; New York Baking Powder Co., New York City	Logan Bros Co. ..
11486	Cleveland's Superior; Cleveland Baking Powder Co., New York City	Mohican Co. .....
11482	Purity; Boston Baking Powder Co., Boston, Mass.	Public Market ....
		HARTFORD:
11472	Imperial; Manhattan Baking Powder Co., New York City	Brown Thompson
11474	Princine; Southern Manufacturing Co., Richmond, Va.	Hartford Market (
11492	Purity; made for the Hartford Market Co., Hartford	Hartford Market (
		NEW HAVEN:
11462	Red Front; The Great Atlantic & Pacific Tea Co., Jersey City, N. J.	Atlantic & Pacific '
11458	Reliable; made for Chas. S. Bernstein, New Haven	C. S. Bernstein ...
11468	Ryzon; General Chemical Co., New York	M. C. Dingwall ...
11457	Benefit, Direct Importing Co., Boston	Direct Importing C
11246	Davis O. K.; R. B. Davis Co., Hoboken, N. J. ...	Logan Co. ....
11499	Our Own; Loveday's, New Haven	Loveday's Tea Stoı
11244	Rumford; Rumford Chemical Works, Providence, R. I.	Mohican Co. .....
11242	Van Dyke Pure; Jas. Van Dyke Co., 50 Barclay St., New York City	Van Dyke Co. ....
11249	Snow Ball; W. A. Higgins, New York	D. M. Welch & Soı
		NEW LONDON:
11488	Grand Union; Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea (
		NORWICH:
11491	Disco; made for Disco Bros., Norwich	Disco Bros. ....
11490	Mohican Cream of Tartar; The Mohican Co., New York City	Mohican Co. ......

BAKING POWDER.

Ingredients Claimed.	Net Weight. Claimed.	Net Weight. Found.	Available carbon dioxide.
	oz.	oz.	%
Acid phosphate of calcium, bicarbonate of soda and corn starch	16.0	16.0	14.61
Acid phosphate of calcium, bicarbonate of soda, carbonate of magnesia and corn starch	4.0	3.9	5.45
Cream of tartar, bicarbonate of soda, tartaric acid (the acid of grapes) and corn starch	8.0	7.9	10.39
Bicarbonate of soda, phosphate of calcium, calcined sulphate of alumina and corn starch	8.0	8.6	11.31
Acid phosphate of calcium, bicarbonate of soda, sodium aluminum sulphate and corn starch	8.0	8.5	11.65
Granular bicarbonate of soda, refined granular phosphate and refined and redried corn starch	8.0	8.7	12.41
Acid phosphate of calcium, sodium aluminum sulphate, bicarbonate of soda and corn starch	8.0	7.8	8.79
Acid phosphate, bicarbonate of soda and corn starch	8.0	8.5	12.06
Acid phosphate of calcium, bicarbonate of soda, sodium aluminum sulphate and corn starch	16.0	17.0	13.66
Monosodium phosphate, sodium bicarbonate and starch	4.0	4.6	9.50
Bicarbonate of soda, carbonate of magnesia, acid phosphate of calcium and best refined corn starch	4.0	4.1	8.65
Acid phosphate, bicarbonate of soda, sodium aluminum sulphate and corn starch	6.0	6.1	11.94
Acid phosphate of calcium, bicarbonate of soda, sodium aluminum sulphate and corn starch	16.0	15.7	9.52
Phosphate, bicarbonate of soda and starch	8.0	8.5	12.52
Phosphates of soda and lime, bicarbonate of soda and corn starch	8.0	8.1	10.20
Sodic aluminic sulphate, phosphate of calcium, bicarbonate of soda and corn starch	8.0	7.9	12.31
Mono-calcium phosphate, basic aluminum sulphate, bicarbonate of soda, corn starch	16.0	15.7	13.07
Acid phosphate of calcium, bicarbonate of soda, sodium aluminum sulphate and corn starch	16.0	15.9	14.32
Cream of tartar, tartaric acid (the acid of grapes), bicarbonate of soda and corn starch	8.0	8.0	11.02

It yields not less than twelve per cent. (12%) of available carbon dioxide.

The acid reacting materials in baking powder are: (1) tartaric acid or its acid salts, (2) acid salts of phosphoric acid, (3) compounds of aluminum, or (4) any combination in substantial proportions of the foregoing.

Announcement of the amounts of calcium sulphate and salts of phosphoric acid which react in baking powder, and of the limits for impurities (arsenic, lead, zinc and fluorides) is reserved pending further investigation.[1]

The modern baking powder is an elaboration of the sour milk—saleratus combination used in the earlier days for "raising" biscuits, bread or cake. Sour milk has been replaced by more convenient materials such as cream of tartar, acid phosphates or alums, while the saleratus (bicarbonate of soda) remains.

The leavening power of baking powder is due to the evolution of carbon dioxide gas which results from the action of the acidic element of the powder upon the bicarbonate. This action does not take place except in the presence of moisture. It follows then that baking powders tend to depreciate in leavening capacity because it is difficult to protect them completely from atmospheric moisture. It is to protect them so far as possible from deterioration from this source that starch, flour or other moisture-absorbing material is generally found as a third ingredient of commercial baking powders.

Low available carbon dioxide content may be the result of faulty preparation of the powder originally, but is more likely due to subsequent deterioration occasioned by long storage or storage under unfavorable conditions. Moisture, once having gained access to a preparation, causes it to decompose rapidly.

Nineteen brands have been examined in the past year and the results appear in Table 1.

Eleven samples contained less than 12 per cent. of available carbon dioxide; in seven of these the deficiency exceeded 10 per cent. of the standard.

Excessive amounts of arsenic have been cited in food products by British and other food journals during the past year. These have been attributed to impurities in the baking powder ingredi-

[1] Food Inspection Decision 174.

ents resulting from the pressure of greatly increased production of chemicals during the war period.

We have not found arsenic in excess in any baking powder examined, none of them containing more than one part per million of this impurity.

GELATIN.

The standard for edible gelatin is as follows:

Gelatin (edible gelatin) is the purified, dried, inodorous product of the hydrolysis, by treatment with boiling water, of certain tissues, as skin, ligaments and bones, from sound animals, and contains not more than two (2) per cent. of ash and not less than fifteen per cent. of nitrogen.

In addition to these requirements good gelatin should be clear in water solution; it should show appreciable jelly strength in 2 per cent. solution; it will not show ordinarily more than 1 part of arsenic in 700,000; and the fat and keratin content should not greatly exceed 0.08 per cent. each. Last-run gelatins have been found to average 0.39 per cent. fat and 0.30 per cent. keratin while first-run glues average 1.00 per cent. fat and 0.69 per cent. keratin.[1]

Gelatin is not a tissue builder but it is of indirect value in the diet on account of its protein-sparing power which is greater than that of carbohydrates.

Gelatin is sold as such for domestic jelly making; and it is largely used in commercial jelly powders and as a stabilizer in ice cream.

The method[1] used for the determination of fat and keratin is as follows:

Digest a 10 gram sample for three or four hours in a mixture of 100 cc. of water and 10 cc. of conc. HCl, cool, introduce into a separatory funnel and extract with 50 cc. of ether. The substance insoluble in dilute acid and in ether (so-called keratin) will separate completely from the acid solution, and will collect as an apparent emulsion in, or below, the ether layer. Discard the clear acid solution. Filter the ether through a dried and weighed filter paper, into a weighed beaker. Wash the residue in the separatory with ether and filter into the same tared beaker. Evaporate the ether and dry the beaker for one hour in a water oven. Weigh the fat.

Wash the "keratin" from the separatory funnel with HCl of about 2%

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[1] Information furnished by A. F. Seeker, Chief, New York Station, U. S. Bureau of Chemistry.

TABLE II.—ANALYSES

Station No.	Brand and Manufacturer.	Net weight of package.	Price of package.
		ozs.	cts.
11477	Baker's. Baker & Co., Washington, D. C.	1.25	10
11455	Benefit. Direct Importing Co., Boston, Mass.	1.32	9
11454	Cooper's. Peter Cooper's Gelatin, Gowanda, N. Y.	1.53	15
11459	Crystal. Crystal Gelatine Co., Boston, Mass.	1.08	13
11460	Grandmother's. The Great Atlantic & Pacific Tea Co., Jersey City, N. J.	1.52	10
11471	[1]Knox. Chas. B. Knox Co., Johnstown, N. Y.	1.44	20
11456	[1]Minute. Minute Tapioca Co., Orange, Mass.	1.22	10
11461	Plymouth Rock. Plymouth Rock Gelatine Co., Boston, Mass.	1.14	15
11470	[2]Swampscott. Swampscott Gelatine Co., Boston, Mass.	1.06	15
11476	[2]Williams	1.69	10

[1] Color accompanying package was a harmless lichen color.
[2] Color accompanying package was a permitted coal tar color, amaranth.

strength, running the washings through the weighed filter. Wash the filter thoroughly with the dilute HCl and dry to constant weight in a water oven.

The results of analyses of ten samples of commercial gelatins examined in the past year are given in Table II.

The analyses show that all samples satisfy the standard requirements as regards nitrogen and ash with the exception of **11476** which exceeds the ash limit by 0.15 per cent. The gelatins in hot water solution were generally not entirely clear; they also possessed a faint odor but it was not in any case offensive. Neither arsenic nor copper were found in objectionable quantities. Judging by the fat and keratin figures, most of the samples may be regarded as first grade products; none can be classed as distinctly inferior.

TEA.

In the course of the work done on tea last year methods for the determination of caffein were studied, the Stahlschmidt and Fendler-Stuber methods being compared.[1] Further results have

[1] Conn. Agr. Exp. Station, Bull. 210, p. 184 (1918).

OF GELATIN.

Ash.	Nitrogen.	Gelatin (N. x 5.55)	Fat.	Keratin.	Undetermined.	Gelatinizing power, 2% solution at 10° C.	Arsenic, parts per million.	Copper.	Appearance and odor of hot water solution.
%	%	%	%	%	%				
1.66	15.12	83.91	0.08	0.05	+0.19	positive	2—	trace	Slightly cloudy; faint odor.
0.71	15.38	85.36	0.06	0.04	+0.57	positive	1	trace	Slightly cloudy; faint odor.
1.55	15.02	83.36	0.09	0.05	+0.15	positive	1	trace	Slightly cloudy; faint odor.
1.17	15.08	83.69	0.12	0.05	+1.23	positive	1	trace	Slightly cloudy; faint odor.
1.31	15.24	84.58	0.22	0.06	+0.96	positive	1	trace	Slightly cloudy; faint odor.
1.58	15.06	83.58	0.05	0.04	+0.24	positive	2—	trace	Clear; faint odor.
0.96	15.24	84.58	0.06	0.04	+1.02	positive	1	trace	Slightly cloudy; faint odor.
0.67	15.40	85.47	0.07	0.03	+1.53	positive	1	trace	Clear; faint odor.
1.47	15.04	83.47	0.19	0.07	+0.50	positive	2+	trace	Cloudy; faint odor.
2.15	15.08	83.69	0.16	0.09	—0.25	positive	2—	trace	Cloudy; faint odor.

been obtained this year by the same methods and a modification[2] of the Fendler-Stuber method has also been tried. The U. S. Standard teas of 1918-1919 have been employed.

The complete data, including results previously obtained, are given in Table III.

TABLE III.—CAFFEIN IN TEA.

Kind of tea.	Modified Stahlschmidt method.		Fendler-Stuber method.		Modified Fendler-Stuber method.	
	By wt.	From N.	By wt.	From N.	By wt.	From N.
	%	%	%	%	%	%
Formosa Oolong, 1	2.20	2.03	2.16	2.12	....	....
Foochow Oolong, 2	2.54	2.44	2.57	2.54	....	....
Congou, 3	1.97	1.89	1.97	1.93	....	....
Ceylon, 4	2.96	2.77	2.81	2.79	....	....
Gunpowder Green, 5	1.86	1.73	1.81	1.76	....	....
Young Hyson Green, 6	1.68	1.54	1.65	1.63	....	....
Pan Fired Japan, 7	2.00	1.94	2.07	2.00	2.11	2.11
Basket Fired Japan, 8	2.07	2.01	2.13	2.11	2.15	2.13
Japan Dust, 9	2.09	1.94	2.18	2.13	....	....
Scented Orange Pekoe, 10	2.71	2.63	2.82	2.73	....	....
Scented Canton, 11	2.93	2.81	2.96	2.91	....	....
Canton Oolong, 12	3.10	2.96	3.27	3.20	....	....

[2] Due to H. A. Lepper, A. O. A. C., Referee on Coffee.

The modifications made in the Fendler-Stuber method are chiefly to correct errors due to evaporation of chloroform during the manipulation.

Further work with these and other methods for caffein will be done during the coming year.

CEREAL PRODUCTS.

Breakfast Foods, etc.

Three samples of Sunseal Brand Cereals have been analyzed, viz., **13163**, Sunseal Sunny Corn; **13164**, Sunseal Cream Corn Meal; and **13165**, Sunseal Improved Hominy Grits.

The analyses are as follows:

Station No.	13163	13164	13165
	%	%	%
Water	12.25	12.02	11.60
Ash	0.38	0.54	0.54
Protein	8.31	8.94	8.50
Fiber	0.35	0.37	0.42
Nitrogen-free extract	78.30	77.10	77.71
Fat	0.41	1.03	1.23

Two samples of corn meal were submitted by the Stoddard Gilbert Co., New Haven for determination of moisture and fat. The products were intended for overseas shipment. **12153**, yellow meal, contained 11.42 per cent. of moisture and 2.55 per cent. of fat. **12154**, white meal, contained 11.22 per cent. of moisture and 3.68 per cent. of fat.

Bread.

Four samples of bread have been submitted by individuals for examination as to their suitability for the dietary of a diabetic patient. The samples were **12884**; **12426**, Loeb's Gluten Bread; **12425**, Loeb's Casein Bread; and **12604**, Health Food Co.'s Glutosac Bread.

The analyses are as follows:

Station No.	12884	12426	12425	12604
	%	%	%	%
Water	34.46	7.85	39.73	23.10
Ash	1.94	1.80	4.35	1.95
Protein (N x 6.25)	26.49	46.65	41.05	32.62
Fiber	0.22	0.22	0.09	0.84
Fat	2.28	11.14	11.07	2.57
Nitrogen-free extract	34.61	32.34	3.71	38.92
Starch	26.81	27.71	trace	20.53

The Casein bread, **12425**, is practically starch-free, and the carbohydrate (nitrogen-free extract) content of the other products is considerably lower than in ordinary wheat bread; but whether or not bread containing from 25 to 30 per cent. of starch is suitable for a diabetic patient is entirely a question of the patient's carbohydrate tolerance.

Prepared and Other Flour.

As stated in the discussion of baking powders, excessive amounts of arsenic have been reported in leavening materials due to faulty manufacture. Nine samples of prepared or self-raising flours have been examined with this feature in mind, but the tests for arsenic in all cases were either negative or inconsiderable, no sample showing in excess of one part per million.

The brands examined were the following:

Station No.	Brand.	Manufacturer.
11245	Aunt Jemima,	Aunt Jemima Mills Co., St. Joseph, Mo.
11247	D. & C.,	D. & C. Co., New York City.
11250	Hecker's,	The Hecker Cereal Co., New York City.
11251	Jim-Dandy,	The D. & C. Co., New York City.
11483	Kaple-Quality,	Cobleskill Milling Co., Cobleskill, N. Y.
11252	Mohican,	Mohican Co., New York City.
11478	Presto,	The H. O. Co., Buffalo, N. Y.
11463	Reliable,	Reliable Flour Co., Boston, Mass.
11453	Victory,	Reliable Flour Co., Boston, Mass.

Seven samples of various flours, sent by individuals, were examined to identify the type of flour or to detect suspected adulteration. None of the samples require particular comment.

FATS AND OILS.

Olive Oil.

Four samples of olive oil submitted by the Dairy and Food Commissioner have been examined. Two were passed and two were adulterated.

The adulterated samples were **14565**, Brand Termini Imerese, sold by Angelo Bergano, 191 Hamilton St., Waterbury and **14579**, no brand, sold by Chas. Barber, 909 E. Main St., Waterbury. Both contained cotton seed oil.

Two samples submitted by individuals were found to be genuine.

Cooking Fats.

A number of cooking fats were examined last year and the analyses were published.[1] One product of this class, viz., *Covo*, has been examined this year as follows:

Halphen test (for cottonseed oil)	Positive
Baudouin test (for sesame oil)	Negative
Refraction at 15.5°, Butyro-refractometer degrees	72.3
Refractive index at 15.5°	1.4737
Reichert-meissel number	0.14
Iodine number	103.2
Renard's test for peanut oil	Positive

The amount of crude arachidic acid obtained from Covo was about 44 per cent. of the amount obtained from a sample of pure peanut oil. The melting point of the arachidic acid as obtained from Covo was 71°-72° and that from pure peanut oil 71°-71.5°. The neutralization value in both cases was 331.

Covo appears to be essentially a mixture of peanut and cottonseed oils.

Butter.

Twenty seven samples of butter have been examined. Of these twenty-one were sold for butter and were found to be as represented. Six were either misrepresented or sold without proper display of notice as to their nature and quality. These samples are as follows:

D. C. No.	Sold for.	Dealer.	Remarks.
		ANSONIA	
15111	Sweet Butter	M. Divorkin, 421 Main St.	Renovated butter
		BRIDGEPORT	
14409	Cooking Butter	Bridgeport Public Market, 110 State St.	Renovated butte
		GREENWICH	
14402	No. 2 Process Butter	Finklestein's Butter and Egg Store, 255 Greenwich Ave.	Renovated butt
		NEW BRITAIN	
14430	Print Butter	Frank Mantner, 54 Rockwell St.	Renovated but

[1] Conn. Agr. Exp. Station, Bull. 210, p. 200.

D. C. No.	Sold for.	Dealer.	Remarks.
		SOUTH NORWALK	
013	Butter	Standard Butter and Egg Co., 12 North Main St.	Renovated butter
14403	Process Butter	H. Scherer, 27 South Main St.	Renovated butter

Of two samples submitted by individuals, one was found to be renovated and the other genuine.

OLEOMARGARINE.

One sample of oleomargarine was submitted and found to be illegal. It was colored with annatto. It was sold by H. C. Tracy, 161-167 Albany Ave., Hartford.

MARKET MILK.

Eleven hundred and ninety-seven samples of milk submitted by the Dairy and Food Commissioner have been examined. The results of analyses permit the following classification:

Not found adulterated	730	61.0%
Adulterated by dilution with water	138	11.5
Adulterated by skimming	22	1.8
Adulterated by reason of being below standard, in solids and solids-not-fat	207	17.3
in solids and fat	7	0.6
in solids, fat and solids-not-fat	93	7.8
Total	1,197	100.0

One hundred and nineteen samples have been received from individuals. Nine were found to be watered, four were skimmed and six were below standard.

We have commented before upon the dangerous practice of diluting milk with water. Both the substance and quality of the milk are lowered from the standpoint of food value; and the danger of introducing the germs of disease, through the medium of a doubtful water supply, into otherwise clean and wholesome milk is too apparent to need elaboration.

The following quotation taken from a very valuable paper[1] on

[1] The Food Value of Milk, by Edna L. Ferry, Conn. Agr. Exp. Sta., Reprint from the Thirty-eighth Report of the Conn. Dairymen's Association (1919).

the food value of milk is a forceful commentary on the practice of watering milk.

"Undiluted milk contains all the vitamine necessary for young animals, but in feeding babies it is the practice to dilute cow's milk with water and to reinforce the mixture with milk sugar. By this procedure the vitamine content of the original mik is so far reduced that the bottle fed baby may get enough of this essential food factor only when it takes a liberal quantity of the food. Whenever appetite fails, the food intake and consequently the vitamine intake is reduced. The effect of this is to further reduce the appetite because the amount of food eaten depends on the vitamine content of the diet. It is thus evident that under such circumstances the child goes from bad to worse and all the endless troubles so familiar to mothers ensue."

This refers to the practice of preparing modified milk for infant feeding which is done on the theory that the modified mixture more closely approximates the composition of human milk. The reduction in vitamine content can perhaps be compensated by increased consumption in some cases. But in families where the supply of milk is kept at a minimum on account of its cost, the seriousness of feeding milk containing 15 to 30 per cent. or more of added water is strikingly apparent, and watchfulness over our milk supply by State and other food officials should in no wise be abated.

In Table IV will be found those official samples of milk found to be adulterated, exclusive of those which were below standard.

TABLE IV.—ADULTERATED MILK.

Dealer.	Solids.	Fat.
Containing Added Water.		
BETHEL.		
W. H. Boardman	11.00	3.5
R. Edmunds	10.27	2.7
G. Finke	10.62	3.2
F. K. Wood	11.35	3.7
F. K. Wood	10.51	2.9
F. K. Wood	11.37	3.8
BLOOMFIELD.		
John Conrey	11.65	3.8
D. Miselli	10.93	3.5
BRANFORD.		
Lewis Sparico	11.06	3.3
BRIDGEPORT.		
Frank Hatch	10.37	3.1
B. Kitain	10.89	3.3
William Schatz	10.40	3.1
BROOKFIELD.		
Robt. Folliott	10.81	3.3
John Hoachman	9.54	2.8
Paul Kanmack	10.51	2.9
Star Kustoss	10.48	3.0
Steve Piskura	10.32	3.1
Steve Piskura	10.19	3.2
Alex Tiburski	10.75	3.5
Alex Tiburski	10.99	3.8
C. S. Williams	10.95	3.5
Edward Waldo	8.92	3.0
Edward Waldo	7.36	2.4
Edward Waldo	8.46	2.7
CANAAN.		
S. Barbieri	11.90	4.2
B. Frink	11.30	3.7
S. Sirlin	7.88	2.4
CHESHIRE.		
Pasquale Guarino	10.87	3.6
Pasquale Guarino	10.00	3.0
Wm. Pavieck	9.89	2.8
CLINTONVILLE.		
Michael Adinolfi	8.79	2.7
Michael Adinolfi	9.45	2.6
Michael Adinolfi	9.91	2.9

No.	Dealer.	Solids.	Fat
	Containing Added Water —continued.		
	COLLINSVILLE.		
16287	G. A. Codaire	11.35	3.8
16370	G. A. Codaire	11.45	3.7
16371	G. A. Codaire	11.18	3.5
16372	G. A. Codaire	11.08	3.6
16373	G. A. Codaire	11.09	3.4
	DANBURY.		
15763	J. G. Abbott	10.51	3.3
16299	Hotel La Bate	3.90	1.1
15753	W. N. Durgy	11.12	3.4
15752	W. N. Durgy	10.65	3.0
15094	C. C. Hatch	13.68	5.6
15758	C. H. Heck	11.86	4.1
15737	K. F. Kaidy	10.26	2.9
15099	Edwin H. Kellogg	11.98	4.2
16296	Robert V. Lears	12.57	6.5
15769	H. S. Rogers	10.83	3.5
16293	W. R. Smith	11.14	3.4
15331	Universalist Church	11.38	3.9
15779	E. K. Wood	10.50	3.1
15759	P. G. Woodin	10.55	3.1
	DERBY.		
14104	Peter Zabouski	11.93	4.1
	EAST BERLIN.		
15014	G. Menthi	10.40	3.6
15015	G. Menthi	10.41	3.5
15016	G. Menthi	9.80	2.9
	EASTON.		
14334	William J. Burr	10.84	3.3
14308	Ernest E. Ferry	10.00	3.0
14309	Ernest E. Ferry	10.65	3.0
14310	Ernest E. Ferry	10.05	2.8
14311	Ernest E. Ferry	10.25	3.1
14312	Ernest E. Ferry	10.29	3.0
14336	G. E. Finke	9.39	2.7
13562	S. Kochis	10.72	3.2
13563	S. Kochis	10.47	3.2
15446	Homer Logan	11.05	3.5
15445	Homer Logan	10.35	3.1
	FAIRFIELD.		
14372	John Vayor	11.01	3.3

TABLE IV.—ADULTERATED MILK.—*Continued.*

No.	Dealer.	Solids.	Fat.
	Containing Added Water —continued.		
	GUILFORD.		
	Gustave Anderson	6.79	2.2
	Gustave Anderson	8.40	3.4
	HAMDEN.		
3	Antone Pascarelle	9.41	3.4
6	John Skapnit	10.39	2.8
7	John Skapnit	11.68	4.4
	HAWLEYVILLE.		
22	H. J. Galpin	9.74	3.1
23	H. J. Galpin	10.01	2.9
24	H. J. Galpin	10.13	3.4
25	H. J. Galpin	9.89	3.2
	HOTCHKISSVILLE.		
461	Howard E. Dayton	10.47	3.1
	LONG HILL.		
4982	Miss H. B. Wells	10.90	3.6
	MELROSE.		
5946	C. A. Thompson	11.00	3.5
15947	C. A. Thompson	11.26	3.6
	MERIDEN.		
15839	Chas. Greenbacker	10.81	3.3
15840	Chas. Greenbacker	11.19	3.4
14944	Ryan & Forrest	11.19	3.8
	NEW BRITAIN.		
13986	T. S. McMahon	11.10	3.5
13994	T. S. McMahon	11.24	3.5
	NEW HAVEN.		
14120	Apens Lunch	9.82	2.6
14354	Diamond Resturant	12.21	4.5
	NEWTOWN.		
14298	Michael Fesch	6.29	1.7
14300	L. W. Whitehead	12.56	4.6
	NORTH HAVEN.		
14918	Antonio Sanzo	10.48	3.4
14919	Antonio Sanzo	9.91	3.0
	OXFORD.	[illegible]	[illegible]

No.	Dealer.	Solids.	Fat.
	Containing Added Water —continued.		
	PATTERSON, N. Y.		
15730	E. T. Haviland	10.73	3.2
	REDDING.		
14328	L. O. Peck	11.23	3.7
14329	L. O. Peck	11.83	4.2
14330	L. O. Peck	11.96	4.1
14325	Geo. P. Williams	12.08	4.2
14326	Geo. P. Williams	10.86	3.
14327	Geo. P. Williams	9.88	2.
15742	G. P. Williams	10.91	3.
15743	G. P. Williams	10.75	3.
15744	G. P. Williams	10.27	3
15745	G. P. Williams	9.74	2
	SANDY HOOK.		
14980	Sam Goldstein	11.18	
14981	Sam Goldstein	10.11	
	SIMSBURY.		
16271	R. H. Robertson	12.36	
	SOUTH MERIDEN.		
15843	Wm. Raven	10.82	
15842	Wm. Raven	10.75	
	SOUTHINGTON.		
15717	Mrs. A. E. Vincent	11.9	
	SUFFIELD.		
15948	A. G. Hinkley	10.8	
15949	A. G. Hinkley	10.	
16252	A. G. Hinkley	10.	
16253	A. G. Hinkley	10.	
16254	A. G. Hinkley	10.	
16255	A. G. Hinkley	10	
16256	A. G. Hinkley	10	
16257	A. G. Hinkley	1	
	TORRINGTON.		
15039	Thomas Hogan	1	
15800	W. J. Twining	1	
15803	W. J. Twining	1	
	TRUMBULL.		
15524	Leonard Pabelke		
15085	John Treadwell		
15086	John Treadwell		

TABLE IV.—ADULTERATED MILK.—*Concluded.*

Dealer.	Solids.	Fat.	No.	Dealer.	Solids.	Fat.
ntaining Added Water —concluded.				*Skimmed Milk—concluded.*		
WALLINGFORD.				FABYON.		
ex Paskiewicz	11.38	3.6	14610	Wilfred Bissonnette	10.75	2.1
WATERTOWN.			14611	Wilfred Bissonnette	12.01	3.1
E. Parker	10.95	3.6		HARTFORD.		
WEST HARTFORD.			13886	Crown Restaurant	11.82	2.9
gan and Williams	10.74	3.3	13889	Crystal Lunch	10.44	1.8
eorge LaRose	9.38	5.8	13888	Hartford Lunch	9.96	1.8
WESTPORT.			15849	W. E. Johnson	10.57	2.2
J. G. Wakeman	11.81	4.0	13890	Middlesex Lunch	10.85	2.1
V. G. Wakeman	10.45	3.5		NEW BRITAIN.		
V. G. Wakeman	9.98	3.0	13893	Arcade Lunch	10.19	1.7
WOODBURY.				NEW HAVEN.		
Chas P. Brown	11.13	3.5	15324	Louis Allison	10.53	2.4
Austin Isham	10.76	3.8	14362	Busy Bee Lunch	9.80	1.6
Albert P. Olsen	11.47	3.9	14592	Heinrich's	10.74	2.3
Albert P. Olsen	11.09	3.8	14367	Longley Lunch, Elm St..	10.38	2.0
Albert P. Olsen	11.49	3.9	14595	Longley Lunch, Church St.	10.02	1.7
NO ADDRESS.			14108	J. F. Markham	11.31	2.5
Antone Pascarelle	8.22	2.6	14357	Restaurant, 421 State St.	10.93	2.4
....	11.12	3.4	14353	Restaurant, 209 State St.	10.46	1.8
Skimmed Milk.			14352	Restaurant, 190 State St.	10.53	2.0
DANBURY.			15325	Tony Rollio	10.93	2.5
Presto Restaurant	9.64	1.7	15316	B. Smirnoff	9.59	1.2
Star Restaurant	10.32	2.1	14599	Tien Tsin	10.37	2.2

CONDENSED MILK.

Fourteen samples of condensed milk have been examined and the results are included in a special bulletin[1] from this laboratory.

CREAM.

Seventeen samples of cream sent by individuals to be tested for milk fat or for thickeners require no particular comment.

[1] Conn. Agr. Exp. Station, Bull. 213. Economy in Feeding the Family, V.

TABLE VI.—ANALYSES OF

Station No.	Brand.
	Soup.
13123	Consomme, Campbell's. Jos. Campbell Co., Camden, N. J. ....
13140	Consomme, Crest. Edw. D. Depew & Co., New York City, Distr...
13120	Consomme, Benefit. Direct Importing Co., Boston, Mass., Distr...
13127	Consomme, Readymaid. Franco-Amer. Food Co., Jersey City, N. J.
13124	Mock Turtle, Franco-Amer. Food Co., Jersey City, N. J. ....
13153	Mock Turtle, Mohican. The Mohican Co., New York City, Distr.
13109	Mock Turtle, Van Camp's. The Van Camp Packing Co., Indianapolis, Ind. ....
13139	Mock Turtle, Epicure. John T. Sills & Sons, New York City .....
13133	[1]Ox Tail, Campbell's. Jos. Campbell Co., Camden, N. J. ....
13121	[1]Ox Tail, Benefit. Direct Importing Co., Boston, Mass., Distr. ....
13125	[2]Ox Tail, Clear. Franco-Amer. Food Co., Jersey City, N. J. ......
	Beef Bouillon.
13119	Benefit. Direct Importing Co., Boston, Mass., Distr. ....
13138	Crest. Edw. D. Depew & Co., New York City, Distr. ....
13135	Frank's Beef Broth with Barley. L. Frank & Son Co., Milwaukee, Wis. ....
13134	Campbell's. Jos. Campbell Co., Camden, N. J. ....
	Clam Bouillon.
13110	Moose-a-Bec, with Clams. Wm. Underwood Co., Boston, Mass. ...
13145	Rex. The Cudahy Packing Co. South Omaha, Neb. ....
13122	Campbell's. Joseph Campbell Co., Camden, N. J. ....
13126	Readymaid. Franco-Amer. Food Co., Jersey City, N. J. ....
	Beef Cubes.
13136	In bulk. As purchased ....
	Prepared as usually directed[4] ....
13128	In bulk. Steero. As purchased ....
	Prepared as usually directed[4] ....
	Clam Extract.
13100	Gorton-Pew Fisheries Co., Gloucester, Mass. As purchased ......
	Prepared as directed ....

[1] 97.8% edible, 2.2% waste (bone). Analysis is of edible portion.
[2] 96.7% edible, 3.3% waste (bone). Analysis is of edible portion.

JAMS AND JELLIES.

Nine samples of jams and fifteen samples of jellies have beer examined with reference to total acidity, total ash, and phos phoric acid content of the ash. It is common practice in th manufacture of jellies of the cheaper grades to use certain acic

SOUPS, BOUILLONS, ETC.

Station No.	Weight of contents. Declared.	Weight of contents. Found.	Cost per can.	Cost per lb.	Water.	Ash.	Ether extract.	Protein (N. x 6.25).	Nitrogen-free extract.	Salt (NaCl).	Nitrogen.
	ozs.	ozs.	cts.	cts.	%	%	%	%	%	%	%
13123	10.5	11.2	10.0	14.4	94.52	1.65	0.07	3.31	0.45	1.50	0.53
13140	10.5	10.2	10.0	15.5	97.23	2.11	0.06	0.44	0.16	1.98	0.07
13120	10.5	10.7	10.0	14.9	96.72	2.25	0.09	0.63	0.31	2.08	0.10
13127	10.5	10.7	13.0	19.4	96.22	2.00	0.03	1.25	0.50	1.82	0.20
13124	10.5	11.1	12.0	17.3	91.56	1.38	0.42	2.94	3.70	1.10	0.47
13153	10.5	10.4	10.0	15.4	87.76	2.73	0.88	3.25	5.38	2.24	0.52
13109	10.5	10.0	10.0	16.0	85.61	2.23	1.38	3.94	6.84	2.01	0.63
13139	10.5	11.4	10.0	14.0	86.43	3.41	1.18	2.00	6.98	3.14	0.32
13133	10.5	11.4	12.0	16.8	82.85	2.78	0.96	3.81	10.60	2.24	0.61
13121	10.5	11.2	10.0	14.4	83.36	3.20	1.35	3.13	8.96	2.64	0.50
13125	8.0	8.6	12.0	22.4	91.48	1.41	1.07	4.06	1.98	0.67	0.65
13119	10.5	10.4	10.0	15.4	97.10	2.14	0.18	0.75	+0.17	1.70	0.12
13138	10.5	9.4	10.0	17.0	97.56	1.98	0.14	0.38	+0.06	1.77	0.06
13135	12.0	11.0	12.0	17.4	92.85	1.87	0.03	1.06	1.94	1.76	0.17
13134	10.5	10.9	12.0	17.6	93.94	2.24	0.03	3.31	0.48	2.05	0.53
13110	10.0	10.7	13.0	19.4	88.13	1.31	1.01	7.06	2.49	0.51	1.13
13145	....	11.2	10.0	14.4	94.52	4.13	0.06	0.88	0.41	3.68	0.14
13122	10.5	11.1	10.0	14.4	94.75	3.01	0.07	1.31	0.86	2.32	0.21
13126	10.5	10.7	13.0	19.4	96.64	2.17	0.02	0.81	0.36	2.05	0.13
13136	....	1.6	20.0[3]	200.0	5.99	77.48	1.29	7.69	7.55	74.72	1.23
	....	....	....	....	98.51	1.23	0.02	0.12	0.12	1.18	0.02
13128	....	1.0	14.9[5]	238.4	9.13	69.68	2.16	15.06	3.97	65.60	2.41
	....	....	....	....	98.56	1.10	0.03	0.24	0.07	1.04	0.04
13100	2.0	2.0	....	....	35.83	29.00	0.19	23.19	11.79	20.80	3.71
	....	....	....	....	98.67	0.60	trace	0.48	0.25	0.43	0.08

[3] One dozen cubes weighed 1.6 ozs. and cost 20 cents.
[4] One average cube weighs 3.8 gms. and a cup of broth is taken to weigh 240 gms.
[5] One cube cost 2 cents; 1 oz. cost 14.9 cents.

to give body or stiffness to the products. Sulphuric, phosphoric, citric or tartaric acids may be used for this purpose but phosphoric acid is said to be preferred. The use of phosphoric acid results in an excess of phosphorus in the ash. According to

TABLE VII.—ANALYSES OF JAMS AND JELLIES.

	Material.	Manufacturer or Distributor.	Total acidity, as sulphuric acid.	Total ash.	
	Jam.		%	%	
30	Apple and Raspberry	Jos. Middleby, Jr., Boston, Mass. ..	0.22	0.374	o
31	Apple and Strawberry	Jos. Middleby, Jr., Boston, Mass. ..	0.31	0.334	o
35	Cherry, pure red	Francis H. Leggett & Co., N. Y. City	0.53	0.275	o
36	Currant, pure red	Francis H. Leggett & Co., N. Y. City	0.73	0.366	o
23	Grape Fruit Marmalade ...	Commercial Groves Co. of Florida, Orlando, Fla.	0.15	0.151	o
32	Raspberry and Apple Juice	Humbert & Andrews, Brookl'n, N. Y.	0.30	0.145	o
33	Strawberry and Apple Juice	Humbert & Andrews, Brookl'n, N. Y.	0.29	0.172	o
29	Strawberry and Apple	Kelley-Clark Co., New York City ..	0.35	0.255	o
54	Strawberry and Apple	Jos. Middleby, Jr., Boston, Mass. ..	0.27	0.380	o
	Jelly.				
39	Apple	Armour & Co., Chicago, Ill.	0.62	0.155	o
41	Apple	P. J. Ritter Conserve Co., Phila., Pa.	0.25	0.180	o
56	Apple	The Whipple Co., Natick, Mass.	0.31	0.260	o
24	Apple and Currant	Wilson & Co., Chicago, Ill.	0.60	0.140	o
28	Crabapple and Apple	Humbert & Andrews, Brookl'n, N. Y.	0.27	0.175	o
40	Crabapple	P. J. Ritter Conserve Co., Phila., Pa.	0.22	0.175	o
37	Currant, red	Francis H. Leggett & Co., N. Y. City	1.12	0.340	o
27	Currant and Apple	Humbert & Andrews, Brookl'n, N. Y.	0.49	0.160	o
26	Grape and Apple	Humbert & Andrews, Brookl'n, N. Y.	0.25	0.180	o
57	Grape and Apple	Armour & Co., Chicago, Ill.	0.75	0.140	o
34	Grape and Apple Pectin ...	Dawson Bros. Mfg. Co., Lynchburg, Va.	0.22	0.082	o
25	Grape, Concord	Pacific Coast Syrup Co., San Francisco, Cal.	0.51	0.410	o
38	Raspberry and Apple	Armour & Co., Chicago, Ill.	0.76	0.130	o
55	Raspberry Flavor Apple ...	The Whipple Co., Natick, Mass.	0.48	0.380	o
58	Strawberry and Apple	Armour & Co., Chicago, Ill.	0.69	0.158	o

Condon,[1] the proportion of phosphorus pentoxide in the ash of jellies made from pure fruit juices should not exceed 5 to 6 per cent. Analyses by Tolman, Munson, and Bigelow[2] show the acidity and ash content of pure fruit jams and jellies.

Our analyses are given in Table VII.

The results for acidity and total ash appear to be within the usual limits for products of the respective kinds. The proportion of phosphorus pentoxide in the ash of the jellies generally

[1] No. Dakota Agr. Exp. Sta., Special Bull., 3, 8 (1914).

[2] Jour. Am. Chem. Soc., 23, 5, 349-351 (1901).

exceeds the limits defined above. The actual amounts of each are so small in some cases that comparatively slight variations in either result in marked changes in the relative proportion, but figures approximating 10 per cent. would seem to be suggestive of added phosphoric acid.

As regards labels, several require particular criticism.

The law requires descriptive matter upon the label to be free from any statement, design, or device regarding the article, or the ingredients thereof, which shall be false or misleading in any particular.[1] This does not permit an article containing a mixture of food products to be named after one of them, even if it be labeled "compound."[2] It does permit prominence to be given to the preponderating ingredient by naming it first on the label;[3] but undue prominence is clearly outside the intent and letter of such regulations.

In case of sample **11532**, a conspicuous legend around the neck of the jar states "Raspberry" while the main label further declares the contents to consist of raspberry and apple juice. Sample **11533** is similar, substituting the word "Strawberry" in place of raspberry.

Samples **11526**, **11527**, and **11528**, are jellies composed of grape and apple, currant and apple, and crabapple and apple respectively; but in each case the words grape, currant and crabapple are emphasized by larger and different colored type in a prominent position.

All these are products of the same manufacturer, viz., Humbert & Andrews, Brooklyn, N. Y.

NON-INTOXICATING CEREAL BEVERAGES OR NEAR BEERS.

Seventeen so-called near beers collected by this Station and nine by the Dairy and Food Commissioner were examined for alcohol content. The brands and manufacturers are as follows:

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[1] Conn. General Statutes, Chap. 128, Sec. 2439.
[2] Conn. Regulation 16, par. d.
[3] Conn Regulation 17.

SAMPLED BY STATION AGENT.

Sta. No.	Brand.	Manufacturer.
13115	*Anzac.*	Anzac Co., Boston, Mass.
13117	*B. B.*	American Beverages Co., Canandaigua, N. Y.
13105	*Bevo.*	Anheuser-Busch Brew. Assoc., St. Louis, Mo.
13132	*Bunny Dry.*	Ropkins & Co., Hartford.
13161	*Cerva.*	Lemp, St. Louis, Mo.
13152	*Colda.*	St. Louis Brewing Assoc., St. Louis, Mo.
13112	*Delphia.*	Anzac Co., Boston, Mass.
13104	*Eblings Extra.*	Ebling Brewing Co., New York City.
13151	*E-Moh.*	The Home Brewing Co., Bridgeport.
13106	*Fifty-Fifty.*	The Fifty-Fifty Corp., Bridgeport.
13166	*Hormo.*	Rubsam & Harrmann Brew. Co., New York City.
13144	*Kovar.*	Piel Bros., East New York.
13142	*Mello.*	John Eichler, New York City.
13131	*Moro.*	The Moro Co., Bridgeport.
13130	*Nebco.*	The New England Brewing Co., Hartford.
13116	*Pablo.*	Pabst, Milwaukee, Wis.
13113	*Sterling.*	Evansville Brewing Co., Evansville, Ind.

SAMPLED BY THE DAIRY AND FOOD COMMISSIONER.

D. C. No.		
15903	*Bevo.*	Anheuser-Busch Brew. Assoc., St. Louis, Mo.
14686	*Bunny Dry.*	Ropkins & Co., Hartford.
15564	*Bunny Dry.*	Ropkins & Co., Hartford.
14687	*Bunny Dry.*	Ropkins & Co., Hartford.
15442	*Fifty-Fifty.*	Fifty-Fifty Corp., Bridgeport.
15906	*Fifty-Fifty.*	Fifty-Fifty Corp., Springfield, Mass.
15905	*Kovar.*	Piel Bros., New York City.
14688	*Nebco.*	The New England Brewing Co., Hartford.
1400	*We-No.*	F. & M. Schaefer B. Co., New York City.

None of these products contained alcohol in excess of 0.5 per cent. except **13151**, *E-Moh,* which contained 0.53 per cent.

B.B., **13117**, *Bunny Dry,* **13132**, **14686**, **14687**, **15564**, and *Pablo,* **13116** are declared to be non-alcoholic. *B.B.* contained 0.15 per cent. alcohol and *Bunny Dry* contained in the 4 samples 0.05, 0.35, 0.44 and 0.40 per cent. respectively. No alcohol was found in *Pablo.* However it is not reasonable to expect beverages of this type to be without traces of alcohol and the declaration "non-intoxicating," which is usually made, is more correct. The manufacturers of *Bunny Dry,* Ropkins & Co., Hartford have changed their declaration to "non-intoxicating."

Two samples of home made beers sent by individuals to be examined for alcohol were found to contain 1.57 per cent. and 1.54 per cent. of alcohol by volume.

CARBONATED SOFT DRINKS.

One hundred carbonated soft drinks submitted by the Dairy and Food Commissioner have been examined for saccharin.

Twelve such products collected by the Station agent and one sent by Miss Bixby of the Bridgeport Health Department have been examined for the same substance.

State Regulation 7 prohibits the use of saccharin in normal foods even if its presence is declared on the label.

Saccharin was found in nineteen samples, all collected by the inspectors of the Dairy and Food Commissioner's Department, as follows:

D. C. No.	Brand.	Dealer or Manufacturer.
15580	Cream Soda.	Harry Owens, Myrtle Ave., Ansonia.
15376	Cream Soda.	Jos. Kent & Son, Elmville.
14657	Cream Soda.	Morris Alterwitz, 20 Court St., Stamford.
15104	Ginger Ale Soda.	G. Luippold, 285 Pembroke St., Bridgeport.
14685	Lemon Soda.	Hamilton Bot. Wks., Hamilton St., New Haven.
14676	Lemon Soda.	New York Bot. Wks., 55 Silver St., New Haven.
14658	Lemon Soda.	Morris Alterwitz, 20 Court St., Stamford.
15105	Lemon Soda.	Morris Alterwitz, 159 Franklin St., Stamford.
15368	Orange Soda.	N. P. White, Danielson.
15109	Orange Soda.	Shanbron Bottling Works, New Haven.
15100	Sarsparilla Soda.	Grey & Lights, Bridgeport.
14659	Sarsparilla Soda.	Morris Alterwitz, 20 Court St., Stamford.
15578	Soda, plain.	I. Dworkin & H. Bogrod, 51 Front St., Ansonia.
14664	Strawberry Soda.	Standard Bottling Works, Bridgeport.
15557	Strawberry Soda.	Chas. Gunning, 19 Grand St., Hartford.
15110	Strawberry Soda.	Golden Eagle Bottling Works, New Haven.
14673	Strawberry Soda.	New York Bottling Works, New Haven.
14666	Strawberry Soda.	I. Silver Bottling Works, Stamford.
15575	Strawberry Soda.	B. H. Godwin, Terryville.

CIDER.

Eleven samples of cider were submitted by individuals and by the Dairy and Food Commissioner. Ten of these were examined for alcohol and one for poisonous or injurious substances. The latter contained no toxic material so far as our examination could discover. Alcohol, by volume, in the other samples ranged from 1.8 to 7.97 per cent.

WINE.

Six samples of wine were examined, chiefly for alcohol content in connection with suspected illegal sales of alcoholic liquors. One of these which was sold at the rate of $70.00 per gallon, contains only 0.47 per cent. of alcohol by volume. Another sample was artificially colored with amaranth.

VINEGAR.

Twenty-five samples of cider vinegar were sent by individuals for examination. Eleven met the requirements of the state standard, viz., 1.6 per cent. of solids and 4 per cent. acidity. Fourteen were below standard in one or both particulars.

Twelve samples were submitted by the Dairy and Food Commissioner. Nine of these were passed and three found to be below standard.

CHOCOLATE AND COCOA.

One sample of chocolate and two of cocoa were examined for the Dairy and Food Commissioner and found to meet the requirements of State Regulation 37 which defines the substance and quality of these products.

MISCELLANEOUS MATERIALS.

Foods, etc.

13137. *Orangeade Paste.* Prepared by Emma Curtis, Melrose, Mass. Fruit flavor for beverages, jellies, frostings and sauces. Artificially colored.

The preparation had the flavor of natural fruit and contains 77.95 per cent. of solids of which 62.11 per cent. was sugar, calculated as cane and invert sugar. The color was Orange 1, a permitted color, and no preservative was found.

11522. *Borden's Coffee* with milk and sugar. Borden's Condensed Milk Co., New York. Stated to contain a small amount of chicory to improve color and flavor.

This is really a sweetened condensed milk with coffee and chicory added. A similar sample labeled Borden's Condensed Coffee, Eagle Brand, is noted in an earlier report.[1]

[1] Conn. Agr. Exp. Station, Bull. 200, p. 140 (1917).

Analyses of both these products are as follows:

Station No.	11522	1917 sample
	%	%
Water	34.02	30.12
Ash	2.19	2.25
Protein (N. x 6.38)	6.83	6.76
Fat	5.70	6.38
Lactose	8.09	9.24
Sucrose	43.17	45.25
Caffein	0.35	0.37

The caffein in both cases is about one third the amount found in ordinary coffee.

13234. *Baking Powder.* The sample contained 10.45 per cent. of available carbon dioxide whereas 12 per cent. is required by the federal standard.

Candy. Caramels, **12751**, were suspected of containing paraffin but no evidence of paraffin was obtained. Tango Kisses, **13407**, were thought to contain considerable amounts of alcohol, but only a trace was found, probably due to the flavoring extract used.

12788. *Canning Compound.* Mrs. Price's Compound, made by the Price Compound Company, Minneapolis, Minn. Other analyses have shown this preparation to consist chiefly of boric acid with a small amount of common salt. The sample submitted to us was tested qualitatively and found to contain boric acid. The sale of this compound itself, as a drug, involves some technical points of law; but clearly the use of such a preservative in food would make such food illegal if sold or offered for sale.[1]

Coffee. Two samples were examined. One, **11672**, was not found to be adulterated. The other, **13406**, was found to consist largely of chicory and cereal products. It was sold as "combination coffee" but later was labeled to show its true composition.

Concentrated Fruit Products. Four samples of concentrated fluid preparations were examined, viz., **11964**, Ideal Concentrated Pineapple Cider; **11965**, Ideal Concentrated Orangeade; **11966**, Ideal Concentrated Grape Cider; and **11967**, Ideal Concentrated Lemonade. The preparations were put up by the American

[1] Conn. General Statutes, Chap. 128, Sec. 2438; Rules and Regulations, Reg. 7, p. 10, par. 3.

Fruit Products Co., New Haven, and stated to be pure fruit products with added coloring.

Examination and partial analyses showed the products to be essentially colored solutions of organic acid or acids, largely or entirely citric acid.

Citric acid is a fruit acid to be sure, but the substance and quality of these preparations is not that indicated by their labels and they are in violation of Chapter 128, Section 2439 of the General Statutes and various State Regulations in connection therewith.

The colors were of the permitted class except that in the case of orangeade, **11965**, the tests were not wholly satisfactory for the permitted orange shade.

It should be noted that these products were not secured in the open market but were sample packages, our information being at that time that they were not in the general trade.

12176. *Condensed Milk.* The sample was examined to explain, if possible, the deep violet color produced when the milk was added to tea. It was found that fresh, whole milk to which a little iron in the form of chloride or sulphate had been added gave a similar color with tannin solutions. This is a recognized reaction between tannins and iron salts in presence of certain phosphates. This sample of condensed milk appeared to have an unexplained excess of iron which combined with the tea tannins to produce the color noted.

13032. *Dried Egg.* The sample contained moisture 8.94 per cent., ash 3.85 per cent., protein 45.56 per cent., and fat 35.87 per cent. It had the appearance and general composition of genuine dehydrated egg.

13232. *Fish* was examined for preservatives but none were detected.

12475. *Honey,* said to be buckwheat honey, was found to be of normal composition.

13211. *Ice Cream Powder* contained no starch and little if any gelatin. Sugar was present and probably vegetable gums.

13627. *Molasses* was of normal sugar content and contained only a small amount (15 milligrams per kilo.), of sulphur dioxid.

12989. *Peanut Oil.* Clarke's Virgin Peanut Oil was exam-

ined. It had a refractive index of 1.4723 at 15.5°C. and no foreign oils were detected.

12131. *Prunes* were examined to identify a white deposit on surface which proved to be sugar.

12416. *Salt.* This was sent as an unknown substance for identification. It was practically pure sodium chloride or common salt.

13554, *Soap,* and **13341,** *Washing Powder,* were both submitted for examination for free alkali. The soap contained 0.02 per cent. of alkali (as Na_2O) and the washing powder contained none.

13496. *Sugar* which showed nearly 100 per cent. sucrose, but was not sufficiently refined to make it pure white.

13384. *Syrup,* Rock Candy. The syrup contained 68.77 per cent. of solids of which 65.81 per cent. was sucrose. There was no evidence of glucose.

15551, *Maple Syrup,* was found to be of standard quality.

FOODS SUSPECTED OF CONTAINING POISON.

Six samples of various food products were submitted to be examined for poisonous substances. One of these was candy, **11819,** which was found to contain bichloride of mercury.

MATERIALS OTHER THAN FOOD EXAMINED FOR POISON.

Nine samples, chiefly stomachs or stomach contents, were examined. The samples were submitted by individuals, health or other authorities to explain, if possible, the sickness or death of animals.

In one case considerable amounts of strychnine and another distinct traces of copper and arsenic were found. In the remaining cases the results of analyses did not indicate the probable cause of death.

II. DRUGS.

SPIRIT OF CAMPHOR.

(*Spiritus Camphorae.*)

"One hundred mils of Spirit of Camphor yield not less than 9.5 gm. nor more than 10.5 gm. of camphor."—*U. S. Pharm. IX.*

Seventeen samples, collected by the Dairy and Food Commissioner, were examined as follows:

TABLE VIII.—ANALYSES OF SPIRIT OF CAMPHOR.

D. C. No.	Dealer.	Grams camphor per 100 mils.
14819	W. J. Madden, Bristol	8.78
14847	Barnum Pharmacy, Danbury	9.55
14875	W. B. Noble, East Hartford	8.41
13882	T. Sisson & Co., Hartford	10.39
14561	H. F. Ruby & Co., Hartford	9.64
14722	S. S. Nelson, Hartford	10.12
14788	Balch & Brown, Manchester	10.79
14777	W. H. Sill, Rockville	5.04
14785	Thomas Pharmacy, Rockville	7.60
14817	A. V. Oxley, Southington	10.61
14799	Thompsonville Drug Co., Thompsonville	14.46
14857	Apothecaries Hall Co., Waterbury	9.27
14752	Bay State Drug Co., Willimantic	10.00
14758	J. W. Lavallie & Co., Willimantic	10.66
14766	Wilson Drug Co., Willimantic	9.54
14773	J. H. Lockwood, Willimantic	9.83
14805	R. J. Keefe, Windsor Locks	9.09

The above samples are quite unsatisfactory. There are few drug preparations of simpler manufacture than spirit of camphor, and yet we find seventeen samples ranging from 5.04 to 14.46 gms. per 100 mils, and ten of these outside the U. S. P. limits. Nos. **14819, 14875, 14777, 14785, 14857,** and **14805** are below the minimum limit, while **14817, 14788,** and **14758** are slightly above, and **14799** very much above, the maximum. No. **14785** was labeled "Tr. Camphor." There is no such U. S. P. preparation and if this was intended to represent a product different from the official article its strength should have been declared on the label.

TINCTURE OF IODINE.

(*Tinctura Iodi.*)

"An alcoholic solution of iodine and potassium iodide. One hundred mils contains not less than 6.5 gm. nor more than 7.5 gm. of I (126.92) and not less than 4.5 gm. nor more than 5.5 gm. of KI (166.02)."—*U. S. Pharm. IX.*

Seventeen samples, collected by the **Dairy and Food Commissioner**, have been examined as follows:

TABLE IX.—ANALYSES OF TINCTURE OF IODINE.

D. C. No.	Dealer.	Grams per 100 mils. I	KI
14820	W. J. Madden, Bristol	7.89	5.78
14848	Barnum Pharmacy, Danbury	6.96	5.35
14874	W. B. Noble, East Hartford	7.41	6.94
13883	T. Sisson & Co., Hartford	6.22	4.54
14560	H. F. Ruby & Co., Hartford	5.87	3.89
14720	S. S. Nelson, Hartford	6.74	4.68
14787	Balch & Brown, Manchester	6.85	5.09
14776	W. H. Sill, Rockville	6.79	5.64
14784	Thomas Pharmacy, Rockville	7.19	5.21
14791	Geo. R. Steele Est., Thompsonville	7.06	4.94
14798	Thompsonville Drug Co., Thompsonville	8.03	4.91
14856	Apothecaries Hall Co., Waterbury	7.46	4.85
14751	Bay State Drug Co., Willimantic	7.22	5.02
14761	J. W. Lavallie & Co., Willimantic	6.78	4.76
14764	Wilson Drug Co., Willimantic	7.06	5.04
14774	J. H. Lockwood, Willimantic	6.78	5.05
14806	J. R. Keefe, Windsor Locks	6.96	4.76

These samples were fairly satisfactory, twelve satisfying the U. S. P. requirements in both respects. The iodine content ranged from 5.87 to 8.03, and the potassium iodide from 3.89 to 6.94 gms. per 100 mils. No. **14820** showed an excess of both ingredients, **14874** an excess of potassium iodide, **13883** a deficiency in iodine, **14560** a deficiency in both ingredients and **14798** an excess of iodine. No. **14560** is the only sample of marked inferiority.

TINCTURE OF FERRIC CHLORIDE.
(*Tinctura Ferri Chloridi.*)

"A hydro-alcoholic solution containing ferric chloride [$Fe Cl_3 = 162.22$] (about 13 per cent.), corresponding to not less than 4.48 per cent. of Fe."—*U. S. Pharm. IX.*

Twelve samples, collected by the Dairy and Food Commissioner, were examined as follows:

TABLE X.—ANALYSES OF TINCTURE OF FERRIC CHLORIDE.

D. C. No.	Dealer.	Iron. %
14822	W. J. Madden, Bristol	4.48
14876	W. B. Noble, East Hartford	4.74
13884	T. Sisson & Co., Hartford	4.78
14562	H. F. Ruby & Co., Hartford	3.68
14790	Balch & Brown, Manchester	4.86
14783	Thomas Pharmacy, Rockville	4.65
14792	Geo. R. Steele Est., Thompsonville	4.66
14855	Apothecaries Hall Co., Waterbury	4.83
14765	Wilson Drug Co., Willimantic	5.00
14753	Bay State Drug Co., Willimantic	5.00
14762	J. W. Lavallie & Co., Willimantic	4.80
14775	J. H. Lockwood, Willimantic	4.56

All of the above are satisfactory except No. **14562**, which contains only 3.68 per cent. of iron, or 82 per cent. of minimum U. S. P. strength.

WITCH HAZEL WATER.

(*Aqua Hamamelidis.*)

"A saturated aqueous liquid obtained by distilling with steam or water the bark, twigs, smaller stems or the entire shrub of *Hamamelis virginiana* Linne, collected in the autumn, and adding 150 mils of alcohol to each 850 mils of the distillate. It contains not less than 14 per cent. of absolute alcohol by volume."—*U. S. Pharm. IX.*

Fourteen samples, collected by the Dairy and Food Commissioner, were tested for alcohol as follows:

TABLE XI.—ANALYSES OF WITCH HAZEL WATER.

D. C. No.	Manufacturer or Dealer	Spec. gr. @ 15.6° C.	Ethyl alcohol by vol.
14821	E. E. Dickinson & Co., Essex	.9821	13.88*
14846	E. E. Dickinson & Co., Essex	.9825	13.80*
14767	E. E. Dickinson & Co., Essex	.9823	14.10
14558	E. E. Dickinson & Co., Essex	.9830	13.70*
14854	E. E. Dickinson & Co., Essex	.9819	14.24
14877	E. E. Dickinson & Co., Essex	.9826	13.76
14754	Gould Witch Hazel Co., Boston, Mass.	.9817	14.56
14719	S. S. Nelson, Hartford	.9824	15.36*
14801	Wm. J. O'Brien, Thompsonville	.9824	13.94
14793	Pond's Extract Co., New York City	.9804	15.10†
14816	A. V. Oxley, Southington	.9823	13.84*
14810	Riker Laboratories, New York City	....	13.88
14804	Sisson Drug Co., Hartford	.9824	13.80
13881	T. Sisson & Co., Hartford	.9825	14.18*

* 15 per cent. claimed. † 16 per cent. claimed.

No wood alcohol was found in any of the samples, and the content of grain alcohol corresponds well with the U. S. P. requirements.

ACETYLSALICYLIC ACID.

(*"Aspirin."*)

Until within a few years this useful and valuable drug was a trade-mark preparation and was best known by its proprietary name "aspirin." The German originators of the drug by an extensive advertising campaign continue in their attempt to make consumers believe that "aspirin, Bayer" possesses virtues not shared by other brands. As a matter of fact "aspirin" is simply pure acetylsalicylic acid and has no virtues not equally common to other pure preparations of this acid, and the latter are generally sold at a much lower price.

Twenty-three samples of the 5 grain tablets, collected by the Dairy and Food Commissioner, have been examined.

TABLE XII.—ACETYLSALICYLIC ACID (ASPIRIN) TABLETS.

Station No.	Manufacturer.	No. of tablets in sample.	Acetylsalicylic acid. Per cent.	Maximum.	Minimum.	Average.
				grs.	grs.	grs.
14721	The Bayer Co., New York City	12	78.96	5.18	4.79	4.97
14729	The Bayer Co., New York City	12	81.90	5.41	4.92	5.18
14756	The Bayer Co., New York City	12	79.12	5.17	4.87	5.01
14772	The Bayer Co., New York City	12	80.00	5.16	4.70	4.99
14818	The Bayer Co., New York City	12	77.50	4.97	4.70	4.82
14879	The Bayer Co., New York City	12	78.68	5.44	4.78	5.04
14832	Bristol Myers Co., Brooklyn, N. Y.	12	83.56	5.09	4.81	4.90
14750	Dusal Chem. Co., New York City	12	78.10	5.00	4.38	4.79
14807	Lehn and Fink, New York City	*8	87.22	5.17	4.81	4.93
14839	Lehn and Fink, New York City	12	80.44	4.96	4.74	4.83
14878	Lehn and Fink, New York City	12	84.20	5.10	4.88	4.99
14782	Eli Lilly, Indianapolis, Ind.	12	78.84	5.31	4.97	5.01
14802	Eli Lilly, Indianapolis, Ind.	10	74.32	4.88	4.63	4.70
14853	Eli Lilly, Indianapolis, Ind.	12	74.06	4.98	4.82	4.90
14780	The Merrill Chem. Co., Cincinnati, Ohio	12	75.84	5.00	4.78	4.91
14781	The Norwich Pharmacal Co., Norwich, N. Y.	12	78.64	5.03	4.85	4.93
14728	Preston Chem. Co., Brooklyn, N. Y. ...	12	84.84	4.75	3.86	4.31
		12	84.82	4.47	3.87	4.19
14771	Preston Chem. Co., Brooklyn, N. Y. ...	12	82.92	5.85	4.74	5.18
14800	Smith, Klein & Clough, Phila, Pa.	12	76.74	5.07	4.83	4.95
14826	Smith, Kline & French Co., Phila., Pa...	12	75.20	5.34	4.50	4.82
14794	United Drug Co., Boston, Mass.	12	79.92	4.94	4.70	4.81
14838	United Drug Co., Boston, Mass.	12	80.68	4.92	4.21	4.66
14858	United Drug Co., Boston, Mass.	12	80.62	5.10	4.57	4.84

* In the same package with these eight tablets were four of quite different size and composition but yielding about the same amount of the drug. These contained 79.74 per cent., or from 4.85 to 4.9[illegible], average 4.90 grs. per tablet.

While there is a general tendency towards a slight deficiency in the drug, with the exception of No. **14728**, made by *Preston Chemical Co.*, the samples are quite satisfactory. The twenty-four tablets in this sample all showed a deficiency, ranging from 0.25 to 1.44 grs. per tablet.

TOILET PREPARATIONS.

Seventy-five samples, collected by the Dairy and Food Commissioner, have been examined solely as regards their alcohol content. The quantity of alcohol has been determined, and in all cases tests made for wood alcohol. The amounts of alcohol are expressed in terms of per cent. by volume.

The following contain no alcohol:

14718. *A. D. S. Liquid Shampoo,* American Druggists Syndicate, New York.

14578. *Witch Hazel Face Lotion,* E. A. & W. E. Child, East Hampton.

The following contain alcohol approximately as declared:

14824. *A. D. S. Almond Cream Compound,* American Druggists Syndicate, New York. Claimed 7, found 7.48 per cent.

14779. *Ayer's Hair Vigor,* J. C. Ayer Co., Lowell, Mass. Claimed 15, found 14.50 per cent.

14851. *Barry's Tricopherous for the Hair,* A. C. Barry, New York. Claimed 81, found 80.70 per cent.

14829. *Colgate's Cashmere Bouquet,* Colgate & Co., New York. Claimed 79, found 77.15 per cent.

14830. *Colgate's Shampoo Mixture,* Colgate & Co., New York. Claimed 34, found 31.16 per cent.

14563. *Danderine,* Knowlton Danderine Co., Chicago. Claimed 9, found 8.10 per cent.

14717. *Danderine Hair Tonic,* Knowlton Danderine Co., Chicago. Claimed 9, found 8.78 per cent.

14827. *Dearco Scalp and Hair Tonic,* Davies, Rose & Co., Boston. Claimed 20, found 20.18 per cent.

14725. *Gill's Lustro for Growth of Hair.* Claimed 40, found 37.40 per cent.

14726. *Guilmartin's Violet Toilet Water,* T. F. Guilmartin, Hartford. Claimed 40, found 40.60 per cent.

14797. *Hobson's Dandruff Remedy,* Pfeiffer Chemical Co., New York. Claimed 3.50, found 4.06 per cent.

14835. *Ilasol,* Riker-Hegeman, New York. Claimed 15, found 14.84 per cent.

14833. *Jergen's Benzoin & Almond,* Andrew Jergen Co., New York. Claimed 10, found 11.86 per cent.

14831. *Jergen's Violet Glycerine Shampoo,* Andrew Jergen Co., New York. Claimed 9, found 8.90 per cent.

14769. *Kickapoo Sage Hair Tonic,* The Kickapoo Indian Medicine Co., Clintonville. Claimed 25, found 24.96 per cent.

14576. *Merton's Hair Tonic,* The Bonheur Co., Syracuse, N. Y. Claimed 48, found 50.25 per cent.

14841. *Nyal's Hirsutone,* Nyal Co., Detroit, Mich. Claimed 8, found 7.46 per cent.

14840. *Nylotis Shaving Lotion,* Nyal Co., Detroit, Mich. Claimed 16, found 15.04 per cent.

14778. *Parisian Sage Hair Tonic,* The Giroux Mfg. Co., Buffalo, N. Y. Claimed 12, found 11.80 per cent.

14755. *Parke, Davis & Co.'s Larkspur Lotion,* Parke, Davis & Co., Detroit, Mich. Claimed 13, found 13.34 per cent by weight, 16.44 by volume.

14825. *Phoebe Snow Eau Vegetal,* Phoebe Snow Laboratories, New York. Claimed 50, found 50.88 per cent.

14843. *Pinaud's Eau de Quinine Hair Tonic,* Ed Pinaud, Paris. Claimed 68, found 66.65 per cent.

14849. *Pompeian Hair Massage,* Pompeian Mfg. Co., Cleveland, Ohio. Claimed 17, found 16.56 per cent.

14770. *Rexall Hair Tonic,* United Drug Co., Boston. Claimed 24, found 23.90 per cent.

14814. *Rexall Tooth Wash,* United Drug Co., Boston. Claimed 35, found 32.46 per cent.

14763. *Royal Ibis Hair Tonic,* Associated Pharmacies, New York. Claimed 16, found 14.40 per cent.

14789. *San-Tox Scalp Wonder,* De Pree Chem. Co., Chicago. Claimed 10, found 10.06 per cent.

14844. *Schieffelin's Florida Water,* Schieffelin & Co., New York. Claimed 60, found 57.75 per cent.

14573. *Seidman's Carnation Hair Tonic,* Nathan Seidman, Hartford. Claimed 10, found 9.70 per cent.

14577. *Seidman's Genuine Sage Head Tonic,* Nathan Seidman, Hartford. Claimed 20, found 21.70 per cent.

14812. *Whitman's Quinine Hair Tonic,* Whitman Chem. Co. Boston. Claimed 30, found 29.00 per cent.

14768. *Wildroot Dandruff Remedy,* Wildroot Chem. Co. Buffalo, N. Y. Claimed not over 40, found 33.06 per cent.

The following contain wood alcohol:

14724. *Gill's Sage Lotion,* sold by T. F. Guilmartin, Hartford. Claimed 50 grain alcohol, found 48.48 per cent. total alcohol, 30.30 per cent. of which is wood alcohol.

14723. *Guilmartin's Eau de Quinine Hair Tonic,* Compound T. F. Guilmartin, Hartford. Claimed 50 grain alcohol, found 40.58 per cent. total alcohol, 15.50 per cent. of which is wood alcohol.

The following contain alcohol in amounts varying widely from claims:

14842. *Colgate's Quinol Hair Tonic,* Colgate & Co., New York. Claimed 35, found 29.16 per cent.

14813. *DeWitt's Toilet Cream,* E. C. DeWitt & Co., New York. Claimed 6, found 2.64 per cent.

14850. *Graham's Hair Color,* Mrs. Gervaise Graham, Chicago. Claimed 25, found 14.02 per cent.

14796. *Hale's Ton-A-Quin Hair Tonic,* H. R. Hale Co., Hartford. Claimed 29, found 32.46 per cent.

14811. *Hall's Vegetable Sicilian Hair Renewer,* R. P. Hall, Nashua, N. H. Claimed 15, found 13.16 per cent.

14852. *Hay's Cocoanut Oil Shampoo,* Philo Hay Specialties Co., Newark, N. J. Claimed 10, found 1.20 per cent.

14867. *Hoffman's Hair Tonic,* F. J. Mangini, Waterbury. Claimed 45, found 40.30 per cent.

14828. *Hudnut's Liquid Green Soap,* Richard Hudnut, New York. Claimed 20, found 16.10 per cent.

14837. *Jayne's Denteen,* Jaynes Drug Co., Boston. Claimed 27, found 22.40 per cent.

14759. *Lavallie's Special Pine Needle Shampoo,* J. W. Lavallie & Co., Willimantic. Claimed 4, found 0.20 per cent.

14559. *Lowe's Liquid Green Soap,* Willis H. Lowe Co., Boston. Claimed 10, found 1.43 per cent.

14873. *Newbro's Herpicide,* The Herpicide Co., Detroit, Mich. Claimed 40, found 35.31 per cent.

14823. *Packer's Liquid Tar Soap,* The Packer Mfg. Co., New York. Claimed 10, found 8.02 per cent.

14757. *Qban Hair Tonic,* Hessig-Ellis Drug Co., Memphis, Tenn. Claimed 25, found 20.96 per cent.

14836. *Riker's Septone Soap,* Riker-Hegeman, New York. Claimed 20, found 17.40 per cent.

14862. *Royal Pearl,* The H. R. Hale Co., Hartford. Claimed 29, found 32.52 per cent.

14786. *San-Tox Hair Tonic,* The De Pree Chem. Co., Chicago. Claimed 15, found 12.66 per cent.

14572. *Seidman's Eau de Quinine Compound Hair Tonic,* Nathan Seidman, Hartford. Claimed 30, found 25.38 per cent.

14574. *Seidman's Compound Hair Tonic,* Nathan Seidman, Hartford. Claimed 30, found 26.80 per cent.

14575. *Seidman's Germicide Famous Hair Tonic.* Nathan Seidman, Hartford. Claimed 30, found 18.70 per cent.

14863. *Toiletine,* The Toiletine Co., Greenfield, Mass. Claimed 15, found 12.84 per cent.

14815. *Vernas Lotion,* Vernas Chem. Co., New York. Claimed 10, found 8.26 per cent.

14834. *Vivandon Lotion Vegetole,* sold by Louis K. Liggett Co., New Britain. Claimed 76, found 70.60 per cent.

14760. *Wyeth's Sage & Sulphur Compound,* Wyeth Chem. Co., New York. Claimed 5, found 4.36 per cent.

14795. *Westphal's Auxiliator,* Paul Westphal, New York. Claimed 55, found 46.30 per cent.

The following contain alcohol without declaration:

14872. *Colgate's Lily of the Valley Toilet Water,* Colgate & Co., New York. Found 67.65 per cent.

14727. *Gill's Lilac Toilet Water,* sold by T. F. Guilmartin, Hartford. Found 33.70 per cent.

14861. *Highby's Witch Hazel and Almond Lotion,* Higby Lotion Co., New Haven. Found 5.86 per cent.

14870. *Ideal Face Cream,* Mark W. Allen, Detroit, Mich. Found 12.78 per cent.

14860. *Kelton Emulsified Cocoanut Oil Shampoo.* Found 3.74 per cent.

14869. *Mangini's Bay Rum,* F. J. Mangini, Waterbury. Found 33.02 per cent.

14865. *Mangini's Lavender Toilet Water,* F. J. Mangini, Waterbury. Found 30.10 per cent.

14866. *Mangini's Lilac Toilet Water,* F. J. Mangini, Waterbury. Found 33.42 per cent.

14845. *Palmer's Violet Toilet Water,* Palmer, New York. Found 92.35 per cent.

14803. *Robertson's Velvet Skin Lotion,* Robertson, Hartford. Found 13.10 per cent.

14808. *San-Tox Liquid Green Soap,* De Pree Chem. Co., Chicago. Found 0.76 per cent.

13885. *Sisson's Quinine Hair Tonic,* T. Sisson & Co., Hartford. Found 51.55 per cent. Quinine present.

14859. *Virginia Clover Toilet Water,* Leigh, New York. Found 69.25 per cent.

14871. *Williams' Khush-Amadi Toilet Water,* The J. B. Williams Co., Glastonbury. Found 72.71 per cent.

Of the 75 samples 2 contained no alcohol, 32 contained grain alcohol in approximately the amounts claimed, 2 contained wood alcohol, 25 contained grain alcohol in amounts at variance with the claims of the label, while 14 contained grain alcohol when none was declared. There is some question as to the necessity of a declaration of alcohol in preparations not making specific curative claims, and probably these samples come within the law.

Gill's Sage Lotion and *Guilmartin's Eau de Quinine Hair Tonic* are distinctly dangerous preparations to use because of their content of wood alcohol and their sale is illegal in this State.

PROPRIETARY REMEDIES.

11518. *Capudine.* (Hicks' Capudine Liquid). Capudine Chemical Co., Raleigh, N. C. For headaches, neuralgia, sciatic rheumatic and periodic pains, sea sickness, train nausea, colds, grippe and nervousness from the use of tobacco.

Examination and analysis showed the following composition:

A brown liquid with a sweet saline taste and the odor of menthol and aromatics. Specific gravity at 15.6° 1.1861; alcohol none; solids 32.46 per cent.; ash 9.16 per cent., containing potassium 2.61 per cent., sodium 0.64 per cent., bromine 5.14 per cent., carbon dioxide present; salicylic acid 2.26 per cent.; caffein 0.71 per cent.; cane sugar 19.10 per cent.; total nitrogen 0.30 per cent.; nitrogen as ammonia 0.08 per cent.

The preparation is essentially a non-alcoholic syrupy liquid containing caffein, bromides and salicylates.

11521. *Diabetina.* Diabetina Company Inc., 3785 Broadway, New York City. Price $2.00 per bottle; contents 8 ounces. Literature accompanying the preparation states: "It is made chiefly from the leaves of certain plants indigenous to South America; contains no habit-forming drug, and only as much alcohol as is absolutely necessary for its preparation. As regards its physiological effects it may be said that it contains one of the very best liver stimulants known to medical science, and is not irritating to the kidneys." Weekly examinations of the urine are recommended and the patient advised to consult a physician at once on the appearance of any sudden increase in sugar elimination. It is suggested that the best way to begin treatment with Diabetina is to live one week on a strict diet of meat soup, beef tea, fish of all kinds, butchers' meat (no liver), poultry, game, eggs, approved green vegetables (a diet list is appended), salads, milk, cream, butter, cheese, cream cheese, tea, coffee, and mineral waters, excluding sugar. Diabetina is to be taken simultaneously as directed and the urine examined for sugar at the end of one week. If the sugar excretion is low carbohydrates may be taken sparingly. It is claimed that while taking Diabetina, carbohydrates may be indulged in moderately and with great benefit in preserving the body albumin and in markedly diminishing acetonuria.

The diet recommended above must, of itself, result in decreased sugar elimination if rigidly adhered to; and the patient looking for evidence as to the merits of Diabetina will want to compare the results of the diet alone with those obtained together with the supplementary treatment.

Examination and analysis showed the following composition:

A dark brown fluid of bitter and astringent taste. Specific gravity at 15.6° 1.1047; alcohol 8.24 per cent.; glycerin none; total solids 27.80 per cent.; reducing sugar as dextrose, before inversion 6.96 per cent., after inversion 7.17 per cent.; total nitrogen 0.257 per cent.; ash 3.14 per cent. (includes calcium oxide 0.15 per cent.; magnesium oxide 0.20 per cent.; sodium oxide 0.22 per cent.; potassium oxide 1.31 per cent.; sulphates, chlorides, and phosphates, traces; carbon dioxide, much); acetates none; citrates trace; ether extract from acid soln. 1.28 per cent. (includes bitter and astringent principles but no emodin-like substances); alkaloid or alkaloids present, unidentified; tannins relatively high.

11519. *Freezone.* The Edward Wesley Co., Distributors, Cincinnati, Ohio. For corns, calluses and warts. Stated to contain alcohol 20 per cent. and ether 300 minims per fluid ounce.

Qualitative examination showed the following ingredients:

Ethyl alcohol; ether; collodion; zinc chloride; salicylic acid.

11514. *Iro-Nux.* Manufacturer not stated. Sold by The Gillespie Drug Co., New Haven, Conn. A laxative iron. Seventy-five tablets cost 75 cents.

Examination and analysis showed the following composition:

Uncoated tablets with bitter taste. Average weight tablet 6.08 grains. Loss at 100° 2.38 per cent.; ash 18.38 per cent. (contains talc 4.78 per cent., iron oxide 10.39 per cent., aluminum oxide 0.37 per cent., calcium oxide 0.64 per cent., and small amounts of potassium, phosphates, chlorides, sulphates and carbonates); ash of water soluble solids 1.28 per cent.; water soluble iron equivalent to 0.22 per cent. Fe_2O_3; total nitrogen 0.09 per cent.; invert sugar 1.80 per cent.; cane sugar 58.14 per cent.; total alkaloids 0.21 per cent. (strychnine and brucine identified); emodin-like substances present, rhubarb identified.

The medicament in these tablets appears to be chiefly saccharated ferrous carbonate, nux-vomica and vegetable cathartics. There is not enough nitrogen to indicate any considerable amount of iron as peptonate.

11513. *Ki-moids.* Scott and Browne, Bloomfield, N. J. For indigestion. Thirty tablets cost 25 cents.

Examination and analysis showed the following composition:

Oval, black tablets with wintergreen odor. Average weight per tablet 4.94 grains. Loss at 100° C. 29.96 per cent.; ash 53.16 per cent.; ash insoluble in acid 0.24 per cent.; total sodium (Na_2O) 30.38 per cent.; sodium bicarbonate 80.64 per cent.; methyl salicylate and rhubarb present.

Protein-digesting power was tested for, using egg albumin in 1 per cent. salt solution as substrate. Ten cc. of this solution were found to contain 0.1044, 0.1024, average 0.1034 gm. protein.

A. Ten cc. egg white solution digested at 80° C. for 15 min. Total nitrogen in coagulum equivalent to 0.1038 gm. protein.

B. Ten cc. egg white solution + 0.3202 gm. tablet powder (equivalent to average weight of one tablet) digested as in A, the enzyme being previously killed by heat. Total nitrogen in coagulum equivalent to 0.1044 gm. protein.

C. Same as B except that enzyme was not destroyed. Total nitrogen in coagulum equivalent to 0.1063 gm. protein.

D. Same as C except that 0.6404 gm. of tablet powder (equivalent to two tablets) was used. Total nitrogen in coagulum equivalent to 0.1088 gm. protein.

We find no evidence that the tablets possess any protein-digesting capacity.

9906. *Tescum Powders.* H. J. Brown Medicine Co., Cleveland, Ohio. A treatment for the liquor habit. Fourteen powders cost $1.00.

Examination and analysis showed the following composition:

Average weight per powder 6.74 grains. Total nitrogen 4.55 per cent.; total chlorine 11.30 per cent.; lactose 76.00 per cent.; gold none found; alkaloid trace, unidentified.

Milk sugar and ammonium chloride constitute over 93 per cent. of each powder.

11520. *Tongaline and Quinine Tablets.* Mellier Drug Company, St. Louis. For malarial conditions and especially those of rheumatic and neuralgic character, etc. Fifty tablets cost 55 cents.

Examination and analysis showed the following composition:

Average weight per tablet 5.78 grains. Loss at 100° 5.09 per cent.; ash 30.12 per cent.; ash insoluble in hydrochloric acid 10.65 per cent.; acid-soluble ash contains mixed iron and aluminum oxides 0.53 per cent.; calcium oxide 1.35 per cent., magnesium oxide 1.61 per cent., potassium oxide 1.01 per cent., sodium oxide 1.43 per cent., sulphate (SO_4) 10.10 per cent. and carbonate small amount; salicylic acid 3.31 per cent.; quinine 4.66 per cent.; emodine-like substances present.

The tablets contain salicylates and quinine. The name suggests, and the tablets probably contain tonga, a mixture of various barks, or an extract thereof, long since recognized as therapeutically inert. The ash constituents are attributable largely to the vegetable drugs present.

11515. *Vitalitas.* Vital Remedies Co., Houston, Texas. "Exclusively produced from our deposit of natural vitalitas mineral." Eight ounces cost $1.00. Stated to be a family remedy for rheumatism, chronic indigestion, impoverished blood and many other disorders.

Examination and analysis showed the following composition:

A light brown liquid with astringent, ferruginous taste. Specific gravity at 15.6° 1.0390; alcohol, glycerin, alkaloids or vegetable extractives none; total iron (Fe) 0.51 per cent., of which 0.42 per cent. is ferrous, and 0.09 per cent. is ferric iron; aluminum (Al) 0.34 per cent.; total sulphate (SO_4) 2.85 per cent.; lime, magnesium, sodium, and potassium slight amounts.

The preparation is an aqueous solution of ferrous, ferric and aluminum sulphates.

11515. B. *Vitalitas Laxatives.* A package of six chocolate coated tablets was included in the carton with the liquid vitalitas described above. Examination showed them to contain vegetable cathartics, cascara being identified. No phenolphthalein was present.

MISCELLANEOUS DRUGS, ETC.

Seven samples of miscellaneous drug preparations were submitted by physicians or individuals for examination.

13369. *Welch's Aegopodium,* was examined for alcohol and found to contain 12.10 per cent. by volume.

13486. *Elixir of Catnip and Fennel Compound.* This is not a U. S. P. or National Formulary preparation but as usually prepared it contains fennel, spearmint, catnip and bicarbonate of soda. Qualitatively the sample appeared to be normal except as regards color and a pronounced peppermint odor.

12574. *Citrate of Magnesia.* The preparation contained 1.29 grams of magnesium oxide and 7.13 grams of citric acid per 100 cc. and had therefore only 86 per cent. of the magnesia and 75.6 per cent. of the citric acid required by the U. S. Pharmacopoeia.

13414, *Goldine, Formula No. 1,* and **13415,** *Goldine, Formula No. 2.* The Goldine Mfg. Co., Buffalo, N. Y., Albany, N. Y. and Bridgeburg, Canada.

Examination and analysis showed the following results:

13414. A brown liquid with sweet vinous odor and a bitter after taste. Specific gravity at 15.6° 1.0295; alcohol by volume 10.95 per cent. The following constituents are in grams per 100 cc.: total solids 11.44; total sugars 9.74; ash 0.32 (contains only slight amount of iron); total nitrogen 0.018; ether extract 0.0576 (contains yellow coloring matter and a bitter principle resembling *coptis* or golden thread); chloroform extract 0.0052 (faint test for alkaloids but no specific alkaloid identified. Tests for strychnine and quinine negative.)

13415. A dark brown liquid with aromatic odor and a sweet vinous taste suggesting wintergreen and sarsaparilla. Specific gravity at 15.6° 1.0225; alcohol by volume 10.92 per cent. The following constituents are in grams per 100 cc.; total solids 9.02; total sugars 7.38; ash 0.34 (contains only slight amount of iron); total nitrogen 0.024; ether extract 0.146 (contains oil of wintergreen, sarsaparilla, coloring matter and bitter principle resembling *coptis*), chloroform extract 0.0116 (alkaloids present

but no specific alkaloid identified; tests for strychnine and quinine negative).

According to information on the cartons there are some twenty-five diseases or disorders for which each of these preparations "has been used with success." We find nothing to convince us of their efficacy against such an array of diseases and believe the chief results will be derived from the alcohol and from the laxative pills with which they are directed to be used.

12653. Medicine sent for identification if possible. The preparation was a pale reddish solution with an orange odor and a saline taste. It contained sugar and the bromides of ammonium, sodium and potassium. Quantitatively it corresponded closely, and was probably intended to be, the National Formulary preparation known as Elixir of Three Bromides.[1]

12586. A white odorless powder with faintly sweet taste. It consisted of 97.6 per cent. of milk sugar but no evidence of mineral or vegetable medicament could be obtained. The powder may have been treated with some of the dilutions of the homeopathic pharmacopoeia.

Seven samples of drugs were sent by physicians, or prosecuting attorneys for identification or analysis, none of which require particular comment.

Other miscellaneous materials, eleven in number, were as follows:

13350, identified as arsenate of lead. **12675,** arsenate of lead, contained 32.11 per cent. of arsenic oxide and 63.17 per cent. of lead oxide. **11771,** bricketts used for fuel, contained moisture 2.54 per cent., volatile and combustible matter 9.56 per cent., fixed carbon 70.70 per cent., and ash 17.20 per cent. **12963** lime-sulphur concentrate, contained lime and sulphur in normal proportions for a solution of high density. **12964** was arsenate of lead which was low in water-soluble arsenic and not excessive in water soluble impurities.

Three samples of water were examined for chlorine content: **13245** was spring water and contained 0.0025 gram of chlorine per litre. **13246** was well water and contained 0.0800 gram per litre. This high chlorine was thought to be due to drainage from road treated with chloride of lime. **13247** was well water

[1] National Formulary, 4th edition, p. 39.

which showed no appreciable chlorine content (0.0025 gram per litre), and the water from which was unobjectionable.

A compound called *"Carbokill,"* **13396,** for use in gasoline to give increased power and prevent carbon accumulation, appeared from the analysis to be commercial naphthaline. The powdered tablets melted at 79°C. and the picric acid derivative melted at 150°C. These figures are in accord with those given by Allen, Mullikin and Scudder and others for pure naphthaline.

Two samples of linseed oil were examined and not found to be adulterated.

SUMMARY.

Materials.	Sampled by: Station Agent.	Sampled by: Dairy and Food Commissioner.	Sampled by: Individuals.	From all sources.	Found adulterated, below standard or otherwise illegal.
Foods.					
Baking powder	19	....	...	19	11
Beverages:					
Non-intoxicating	17	9	...	26	6
Home-made beer	...	....	2	2	...
Soft drinks	12	100	1	113	19
Cider	...	1	10	11	...
Wine	...	....	6	6	...
Cereal products:					
Breakfast foods	3	....	2	5	...
Bread	...	....	4	4	...
Flour	9	....	7	16	...
Chocolate and cocoa	...	3	...	3	...
Fats and Oils:					
Olive oil	...	4	2	6	2
Cooking fats	1	....	...	1	...
Butter	...	27	2	29	6
Oleomargarine	...	1	...	1	1
Gelatin	10	....	...	10	...
Ice cream	...	330	18	348	35
Jams and jellies	24	....	...	24	5
Milk and Milk Products:					
Market milk	...	1,197	119	1,316	486
Condensed milk	14	....	...	14	...
Cream	...	12	17	29	...
Human milk	...	....	12	12	...
Soups and bouillons	22	....	...	22	...
Vinegar	...	12	25	37	17
Miscellaneous	6	1	32	39	...
Total	137*	1,697	259	2,093	588
Drugs.					
Aspirin	...	23	...	23	1
Proprietary remedies	9	....	...	9	...
Spirit of Camphor	...	17	...	17	10
Tincture of Ferric Chloride	...	12	...	12	1
Tincture of Iodine	...	17	...	17	5
Toilet preparations	...	75	...	75	27
Witch Hazel	...	14	...	14	...
Miscellaneous	...	....	25	25	...
Total	9	158	25	192	44
Total, foods and drugs	146	1,855	284	2,285	632

* Exclusive of diabetic food products examined.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 220 FEBRUARY, 1920

BEING THE

Twenty-Fourth Report

ON

Food Products

AND

Twelfth Report on Drug Products.

PART II (Diabetic Foods).

By E. M. BAILEY.

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the editions permit.

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Part II (Diabetic Foods).

By E. M. Bailey.

INTRODUCTION.

Present knowledge of diabetes does not permit of an entirely satisfactory definition of the disease; it is generally defined in terms of its most conspicuous symptom, viz., the elimination of glucose in the urine. Joslin's[1] definition is so stated; he regards diabetes as an abnormal condition of metabolism in which the faculty of properly utilizing carbohydrates is partly or wholly lost, and in consequence of which glucose appears in excessive amounts in the urine. The excretion of sugar (called a condition of glycosuria) should not be regarded as synonymous with diabetes; it is a symptom, not the disease itself.

Another definition of diabetes has been formulated by Allen[2] based upon what he conceives to be the cause of the disease. He believes that, normally, sugar is combined with some substance, furnished by the pancreas, which makes it available to the body tissues. When not so combined, as in case of a deficiency of this pancreatic function, sugar is not utilized and glycosuria results. Diabetes, according to this conception, is a deficiency of internal secretion of the pancreas. This is the amboceptor hypothesis.

Tibbles[3] quotes Sir J. Rose Bradford who says "diabetes is not an entity, but a clinical label attached to a number of different conditions with varied origins, different morbid anatomy, and liable to follow different courses." This is known as the theory of multiple causes and permits of considerable latitude of application.

Rôle of carbohydrates. Whatever definition may be accepted, it is the metabolism of carbohydrates which, in diabetes, is most profoundly disturbed. With non-diabetic individuals the greater

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[1] Joslin, E. P., The Treatment of Diabetes Mellitus, New York, 1917.
[2] Allen, F. M., Glycosuria and Diabetes, Boston, 1913.
[3] Tibbles, Wm., Food in Health and Disease, New York, 1914.

the intake of carbohydrates the greater the utilization[1]; but with diabetics the reverse is true, i. e. the excretion of sugar increases with increased ingestion of carbohydrate-bearing foods, and therefore the limitation and control of this type of foods becomes a part of every plan of diabetic treatment. It is no longer considered necessary or advisable to uniformly exclude carbohydrates from the patient's diet but rather to allow as much of such material as he will tolerate. The claims often made that one kind of carbohydrate is better tolerated than another are generally without foundation, or based upon inadequate proof. There is no convincing evidence, for example, that starch from one source is better assimilated than that from another; and the advantages of certain sugars over others from the standpoint of utilization are often predicated upon apparent rather than real tolerance.

Rôle of fat. In diabetes of the more severe types impaired metabolism is not confined to carbohydrates but extends to fats and proteins. Although it appears that fats are absorbed quite as well by diabetics as by normal individuals they are not equally well utilized in metabolism. Consequently the introduction of increased amounts of fat into the diet to compensate for the withdrawal of carbohydrate is attended with danger of acidosis, i. e., incomplete oxidation of fatty acids with elimination of intermediate products, viz., β-oxybutyric acid and aceto-acetic acid. Acetone may also be eliminated.

Authorities differ as to whether sugar can arise from fatty foods. von Noorden[2] and others maintain that the liver possesses the power to effect such a transformation but that it is a facultative function exercised only as necessity requires. According to Ringer[3] glucose may be formed from certain fatty acids but there is no evidence that fat itself produces glucose in diabetes. The increased glucose elimination after fat feeding in diabetic treatment is probably due to the stimulating action of fat on protein metabolism.[4]

Rôle of protein. In the process of digestion protein is broken down into simpler substances called amino acids which are then

[1] Allen's Paradoxical Law.

[2] von Noorden, Carl, New Aspects of Diabetes. New York, 1912.

[3] Jour. Exp. Med., 12, 1910.

[4] Janney, N. W., Archiv Intern. Med., 18, 1916.

utilized for the various body requirements. The nitrogenous part of these protein derivatives is ultimately eliminated chiefly as urea; the non-nitrogenous portion is either burned as fuel or converted into carbohydrate and, directly or indirectly, into fat. In diabetes this protein-derived carbohydrate may be excreted just as in case of carbohydrate ingested as such.

Although the formation of glucose from protein in metabolism has been recognized it does not appear to have been adequately appreciated in practical diabetic treatment. Its origin was formerly attributed to a supposed carbohydrate complex in the protein molecule, but carbohydrate, as such, is no longer regarded as a constituent of protein; the insignificant amount sometimes found is looked upon as an impurity.

The work of Lusk, Dakin, Janney[1] and others has shown that the amino acids which arise from protein in digestion are the glucose-yielding materials and the amount of glucose formed is in direct proportion to the amino acid content of the particular protein ingested. There is no distinction between animal and vegetable proteins as regards sugar-producing capacity. Glucose arises not only from the protein as ordinarily ingested in food but also from the feeding of pure isolated proteins and from the breaking down of body protein as well. These facts are shown by the experiments of Janney with completely diabetic (phlorizinized) dogs, a condition which he considers, particularly as regards glucose-formation from protein, essentially comparable with severe human diabetes.

Protein-glucose factors. The glucose factors of a number of pure proteins, both animal and vegetable, as derived by Janney are given as follows:

TABLE I.—GLUCOSE YIELDS OF INGESTED PROTEINS (JANNEY).

	Casein.	Ovalbumin.	Serum albumin.	Gelatin.	Fibrin.	Edestin (Hemp protein).	Gliadin (Wheat protein).	Zein (Corn protein).
Glucose yield in per cent.	48	54	55	65	53	65	80	53

[1] Janney, N. W., Archiv. Intern. Med., **18**, 1916.

Glucose yields of protein foods. The following data, taken from the same source, show the glucose yields of a variety of common protein foods.

TABLE II.—GLUCOSE FORMATION FROM PROTEIN FOOD; COMPARATIVE TABLE, (JANNEY).

	Water content per cent.	Glucose yield, per cent.	Amount equivalent to 100 gm. bread.	Calories per 100 gm.
			gm.	
Beef, raw	74.8	9.5	642	150
Beef, broiled	54†	17.5	348	208
Beef, dried or smoked	54.3	21	290	185
Beef, canned or corned	51.8	18.2	335	270
Beef, roasted	48.2	19.5	313	241
Chicken meat, raw	74.5	12	508	197
Chicken meat, roasted	59.9	19.2	317	245
Rabbit, raw	74.7	11	555	...
Rabbit, broiled	61.4†	16.8	363	...
Halibut steak, raw	75.4	12	508	124
Halibut steak, fried	54.2†	22.3	255	173
Eggs, raw	73.7	10.3	592	153
Eggs, boiled	73.2	10.51	580	166
Eggs, fried	70.4†	11.6	526	160
Ovalbumin*	....	54	113	...
Gelatin*	....	65	94	366
Casein*	....	48	127	...
Corn protein, zein*	....	53	115	...
Wheat protein, gliadin*	....	80	76	...
Flour*	....	92.5	...	...
Bread	34‡	61	...	277

* Calculation based on water-free material.
† Writers' analysis.
‡ Analyses from Conn. Agric. Exp. Station Report, Sec. 1, Diabetic Foods, 1913.

Whether the factors given above may or may not be accepted as absolute by reason of the particular conditions under which the experiments were conducted, nevertheless it is evident that taking protein into account as a potential source of glucose places a very different aspect upon certain types of foods as regards their adaptability or usefulness in the diabetic dietary. For example, it is common practice to evaluate diabetic foods on the basis of a comparison between their carbohydrate content and that of a typical and staple carbohydrate food, viz., wheat bread, after the plan proposed by von Noorden. While, as generally stated, such comparisons are technically correct they are mislead-

ing in that they do not recognize the protein of the food as a possible contributing source of carbohydrate.

Bread equivalents. As an illustration of the application of the foregoing data in computing bread equivalents we make use of the same products as cited by Janney. His table has been modified by stating the protein on the basis of the factor 5.70 for wheat products which changes the carbohydrate content correspondingly; by the addition of a bread equivalent column as calculated after the plan of von Noorden which has been the usage in this laboratory; and also by applying the glucose factor .48 in estimating the glucose yield of the casein preparations Sanatogen and Plasmon which, by oversight, was not done in the original tabulation.

The factor derived by Janney for computing the glucose yield of the protein of wheat is .705. To obtain the bread equivalent by his method add to the carbohydrate content of the food the per cent. of glucose formed from the protein therein using the appropriate factor, i. e., .705 for wheat and .48 for casein. The standard of comparison is the glucose yield of bread in metabolism calculated to be 61. von Noorden equivalents are based on the average carbohydrate content of wheat bread, viz., 53 per cent.

TABLE III.—GLUCOSE FORMATION FROM DIABETIC FOODS.

	Protein.	Carbohydrate.	Glucose yield in metabolism.	Amount equivalent to 100 grams of bread.	
				Janney.	von Noorden.
	%	%	%		
Glidine	83.3	9.1	68	90	582
Sanatogen	80.1	4.2	43	142	1,262
Plasmon	78.7	0.0	38	160	....
Diabetic biscuit	23.1	61.2	77	79	87
40% Gluten biscuit	32.7	57.1	80	76	93
80% Gluten biscuit	75.1	11.7	65	94	453

Recognizing, as the author of these experiments does, that in actual practice many factors obtain which are absent or cannot be simulated in experiment, such, for example, as rate and extent of assimilation, influence of other food in the diet, texture of the food and the proportion of indigestible matter, and variations in carbohydrate tolerance, and that therefore protein-glucose factors

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must be regarded as relative rather than absolute, yet the reduction of carbohydrate in any food or diet to a negligible minimum appears to be unwarranted effort when accompanied by correspondingly high protein. Thus we see from the above table that Glidine with 9 per cent. of carbohydrate and 83 per cent. of protein may in certain severe diabetic conditions yield but little less glucose in metabolism than diabetic biscuit with over six times as much carbohydrate and three-tenths as much protein.

If, then, carbohydrate foods aggravate the diabetic's most conspicuous symptom, i. e., glycosuria; and if from one-half to two-thirds of his protein intake may be converted into sugar in the course of metabolism; and if, directly or indirectly, fats contribute to his sugar elimination from the body, what may he eat? Since Janney has formulated the same question, we quote his answer:

"This question has indeed been logically answered by Allen, whose well-known treatment has emphasized the good results to be obtained from a complete fast. The rationale of the Allen treatment becomes more evident when one is mindful of the fact that not carbohydrates alone, but all the three great classes of foodstuffs may give rise to increased glucose formation. Thus it becomes apparent that only by total exclusion of all food, a complete rest can be given to the sugar-utilizing function of the organism.

"The diabetic, however, cannot refrain indefinitely from food. How, then, feed him? In view of the series of experiments here reported it is likely that a diet containing moderate amounts of protein and fat and low amounts of carbohydrate is after all the most judicious one to be employed. It seems that only by very discriminately balancing the various advantages and disadvantages of each kind of foodstuff can the proper quantity for a given case be best determined."

WHAT CONSTITUTES A "DIABETIC" FOOD.

The question of what a diabetic food is, or should be, becomes increasingly difficult to answer. There is no universal diabetic food. It becomes more and more apparent that diabetic diets must be arranged strictly according to individual tolerance. The efforts of manufacturers of foods particularly adapted to the

treatment of diabetes appear in many cases to be centered upon the production of an absolutely carbohydrate-free product. No doubt they have been catering to a popular belief, and a belief fostered in many instances by members of the medical and other professions. Probably Allen suggests the reason for this when he emphasizes the fact that the symptom, viz., glycosuria, and the disease, viz., diabetes, have been frequently confused; and again when he quotes Abderhalden, who says: "Up to the present time the most prominent symptom, that of glycosuria, has dominated the entire investigation of problems concerning diabetes, and it is very probable that this is the reason why the disease, as a whole, is so little understood."

Federal definition.[1] The Federal regulation regarding *"diabetic food"* is as follows:

"Although most foods may be suitable under certain conditions for the use of persons suffering from diabetes, the term 'diabetic' as applied to food indicates a considerable lessening of the carbohydrates found in ordinary products of the same class, and this belief is fostered by many manufacturers on their labels and in their advertising literature.

"A 'Diabetic' food contains not more than one-half as much glycogenic carbohydrates as the normal food of the same class. Any statement on the label which gives the impression that any single food in unlimited quantity is suitable for the diabetic patient is false and misleading."

The Federal definitions also describe the substance and quality of gluten products as follows:

"Ground gluten is the clean, sound product made from wheat flour by the almost complete removal of starch and contains not more than ten per cent. (10%) of moisture, and, calculated on the water-free basis, not less than fourteen and two-tenths per cent. (14.2%) of nitrogen, not more than fifteen per cent. (15%) of nitrogen-free extract (using the factor 5.7), and not more than five and five-tenths per cent. (5.5%) of starch (as determined by the diastase method).

"Gluten flour is the clean, sound product made from wheat flour by the removal of a large part of the starch and contains not more than ten per cent. (10%) of moisture, and, calculated on the water-free basis not less than seven and one-tenth per cent. (7.1%) of nitrogen, not more than fifty-six per cent. (56%) of nitrogen-free extract (using the protein factor 5.7), and not more than forty-four per cent. (44%) of starch (as determined by the diastase method).

"Gluten flour, self-raising, is a gluten flour containing not more than ten per cent (10%) of moisture, and leavening agents with or without salt."

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[1] U. S. Dept. Agr., Food Inspection Decision 160.

Other desirable requirements. In addition to this, Street and Mendel[1] have formulated requirements which may well apply.

1. "The label should bear a correct statement of the percentages of protein, fat and carbohydrates present.
2. "The amounts of the different carbohydrates present should be declared on the label, i. e., starch, sucrose, levulose, lactose, etc.
3. "The process of manufacture should be so standardized that uniformity of composition, within reasonable limits, will be maintained from year to year."

These recommendations, particularly the first and third, are important. It is quite general for manufacturers to emphasize low carbohydrate or high protein, but it is essential for the physician to know both these constituents and the fat content as well. The desirability of uniformity needs no argument.

INSPECTIONS OF COMMERCIAL DIABETIC PRODUCTS.

Previous inspections. Since 1906 this laboratory has been interested in the subject of diabetic foods. At intervals since that time we have examined products of this class for the purpose of keeping in touch with progress and improvement in the manufacture of such foods. Our efforts have met with appreciative response both from the medical profession and from manufacturers as well. Both realize the importance of reliable information regarding the composition of various foods for the intelligent preparation of a diabetic diet.

Purpose and scope of present inspection. The present revision or resurvey of the field was made in response to frequent inquiries as to the present composition of various brands of these specialized foods; also to examine such new preparations as might be available.

The time chosen was perhaps unfortunate by reason of the fact that, on account of war conditions, some manufacturers had curtailed or suspended production, and that few imported brands were available. However, we believe that the majority of foods of this type used in this country to-day are represented in our new analyses.

In addition to the analyses of strictly commercial foods, we have examined other preparations which are of particular interest

[1] Conn. Agr. Exp. Sta. Report, Part 1, Sec. 1, 1913.

in diabetic treatment. Such include washed bran, thrice-cooked vegetables, diabetic broths and various substitutes for milk.

Besides our own new analyses, the valuable compilation contained in our Report for 1913 has been revised and enlarged to include our latest results as well as results obtained in other laboratories.

SOURCES OF MATERIALS EXAMINED.

Samples were obtained largely by our direct request addressed to manufacturers. We are indebted to them for their coöperation. We are also indebted to Prof. Lafayette B. Mendel, Referee on Diabetic Foods for the American Medical Association, who enlisted the aid of that Association, and with whom it has been our privilege to consult; to Dr. E. P. Joslin of Boston, who early volunteered to enlist the interest of his professional friends in our project, and who personally submitted samples; to Dr. N. W. Janney, Director of the Memorial Laboratory and Clinic, Santa Barbara, Calif., both for suggestions and for samples of soy bean milk and almond milk with formulas for preparing the same; to Dr. F. M. Allen, U. S. A. General Hospital No. 9, Lakewood, N. J., Dr. T. B. Osborne of this Station, and Mr. J. P. Street, formerly chief of this Laboratory, for suggestions and criticisms; and to Miss Geraghty, formerly Dietitian of the New Haven Hospital, and to her assistant, Miss Hoffman, for experimental work with recipes designed for diabetic dietaries.

METHODS OF ANALYSIS.

The methods used have been those authorized by the Association of Official Agricultural Chemists. The determination of fat has been modified in case of baked goods. It has been shown that the usual continuous extraction may not remove fat satisfactorily from baked products, e. g., bread. We have therefore used the following method in such cases:

Method for determination of fat in baked products[1]:—Treat 5 gms. of material in a loosely stoppered 200 cc. Erlenmeyer flask with a mixture of 10 cc. alcohol (95%), 2 cc. concentrated ammonia and 3 cc. of water, heating 2 minutes at the boiling point. Cool, add three successive portions of 25 cc. of ethyl ether, mixing thoroughly, and tamping the material

[1] Conn. Agr. Exp. Sta., Bull. 200, p. 133, 1917.

each time with a glass rod flattened at the end, pouring off the extracts into a 200 cc. beaker. The combined ether extracts are evaporated to dryness on the steam bath. The crude fat is extracted by washing out with several portions of anhydrous ether, or preferably petroleum ether, the extract collected in a tared flask, evaporated and dried for periods of 30 minutes at 100° C. until constant weight is obtained.

INTERPRETATION OF ANALYSES.

Protein. The proper basis for comparison of the nitrogenous material in diabetic or other foods is the nitrogen content. But proximate analyses require a statement of protein content and this is ordinarily obtained from the nitrogen figure by use of the conventional factor 6.25, which is based on the assumption that protein contains 16 per cent. of nitrogen.

The Federal definition and standard for "gluten" products is based upon the observation that wheat proteins contain about 17.5 per cent. of nitrogen which requires a factor of 5.70 to express the protein in wheat products.

This being the case, we have used the factor 5.70 to calculate the protein in such materials as are known, or declared, to be gluten products. In all other cases the conventional factor 6.25 has been used. It is recognized that 6.38 is a more correct factor for milk proteins, but a variation of 0.13 in the factor is almost within the limit of analytical error and certainly within the limits of variation in factory control of these products from time to time, so that no attempt has been made to apply this more accurate factor to casein preparations.

Nitrogen-free extract. The interpretation of this term has been made clear in previous reports but it may be briefly restated. In proximate analyses nitrogen-free extract is an expression used to cover the difference between 100 per cent. and the sum of the percentage amounts of moisture, ash, protein, fiber and ether extract (crude fat). In general it so closely approximates the total carbohydrates, i. e., starch, sugars, etc., that the term is used synonymously with carbohydrate. Obviously, the percentage of this constituent group varies according to the protein factor used. In other words, it will be higher if 5.70 is used to calculate protein than if 6.25 is employed.

In addition to starch, nitrogen-free extract includes carbohydrates which we may call available, accepting the term "avail-

able" to mean those materials which directly reduce Fehling's solution or do so after treatment with acid and therefore presumably yield glucose in metabolism, and carbohydrates which are non-available or less available in human metabolism. The first class includes soluble starch, dextrins, maltose, glucose, sucrose, invert sugar, raffinose, lactose and some other less common sugars. The second group includes substances, collectively termed hemicelluloses, which occur as vegetable cell-wall constituents, and soluble vegetable gums and mucilages sometimes called saccharo-colloids. Although these compounds yield sugars of the hexose and pentose types, it is doubtful if they play any considerable part in metabolism other than that of the ruminant animals.

The interpretation of nitrogen-free extract, represented by a figure obtained by difference, as synonymous with carbohydrate, does injustice to certain diabetic food products, notably casein preparations, which are free or practically free from carbohydrates.

In our tables of analyses starch is indicated as a part of the nitrogen-free extract; the remainder represents the difference from 100 per cent. as stated.

NEW ANALYSES OF COMMERCIAL DIABETIC PRODUCTS.

Our 1919 inspection of diabetic preparations may be classified as follows:

Commercial products		85
Commercial and experimental products:		
Washed bran	3	
Experimental recipes with bran	2	
Thrice-cooked and other vegetables	4	
Diabetic broths	9	
Artificial or modified milks	4	22
Total		107

The efficient coöperation of Messrs. R. E. Andrew, C. E. Shepard, H. D. Edmond and M. A. D'Esopo, to whom all analytical work is due, is gladly acknowledged. Acknowledgment is also made to Miss Alta H. Moss for her assistance in the work of compilation.

The analyses of eighty-five commercial products are given in Table IV.

TABLE IV.—ANALYSES OF

Station No.	Manufacturer and Brand.
	Herman Barker, Somerville, Mass.
13096	Gluten Food "A"
13097	Gluten Food "B"
13098	Gluten Food "C"
	The Cereo Co., Tappan, N. Y.
13099	Soy Bean Gruel Flour
	The Farwell & Rhines Co., Watertown, N. Y.
13066	Genuine Gluten Flour 40%
	Golden Rod Milling Co., Portland, Ore.
13059	Acme Special Flour
	Health Food Co., New York.
13076	Almond Meal
13083	Alpha
13244	Alpha No. 1 Best Diabetic Wafer. Casein
13245	Alpha No. 2 Best Diabetic Wafer
13091	Bran Biskue. Gluten Bran
13077	Diabetic Casein Flour (self-raising)
13073	Gluten Cracker-Dust
13082	Glutona Bread Sticks
13220	Glutosac Bread
12604	Glutosac Bread
13088	Glutosac Butter Wafers
13079	Glutosac Gluten Flour
13092	Gluten Nuggets
13085	Glutosac Rusk
13089	Glutosac Wafers Plain
13090	Glutosac Zwieback
13072	Manana Gluten Breakfast Food
13081	Pronireu. A Gluten Griddle Cake Flour
13221	Protosac Bread No. 1
13222	Protosac Bread No. 2
13074	Proto Puffs No. 1
13219	Protosac Rusk
13075	Protosoy (Cereal)
13084	Protosoy Diabetic Wafer
13078	Protosoy Soy Flour
13080	Pure Washed Gluten Flour
13086	Salvia Almond Sticks
13403	Snow Flake Diabetic Casein Flour
	Huntley and Palmer, London.
13326	Akoll Biscuits

DIABETIC FOODS.

Station No.	Weight declared.	Weight found.	Water.	Ash.	Nitrogen.	Protein. N x 6.25.	Protein. N x 5.70.	Fiber.	N-free extract. Starch.	N-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	gms.	gms.	%	%	%	%	%	%	%	%	%	
13096	368	363	9.86	0.29	13.50	.....	76.95	0.06	2.56	9.84	0.44	361
13097	368	354	9.72	0.33	12.98	.....	73.99	0.08	5.23	10.14	0.51	362
13098	368	343	10.00	0.42	12.79	.....	72.90	0.09	6.39	9.80	0.40	360
13099	396	387	6.12	3.98	7.38	46.13	.....	2.38	0.90	21.86	18.63	443
13066	1361	1388	10.65	0.75	7.10	.....	40.47	0.23	37.01	9.42	1.47	361
13059	4540	....	11.73	1.02	2.42	15.13	.....	0.33	61.48	8.56	1.75	356
13076	....	222	7.90	6.01	8.04	50.25	.....	2.40	none	18.00	15.44	412
13083	93	142	9.48	5.76	10.97	68.56	.....	0.35	1.01	6.40	8.44	380
13244	93	125	6.81	6.23	7.74	48.38	.....	0.17	none	4.89	33.52	515
13245	93	140	12.88	5.09	11.28	70.50	.....	0.13	1.13	6.25	4.02	348
13091	426	442	9.19	3.38	4.85	.....	27.65	1.51	33.84	13.90	10.53	396
13077	227	267	11.93	9.16	11.56	72.25	.....	0.14	none	5.73	0.79	319
13073	383	391	8.58	2.42	7.81	.....	44.52	0.71	23.18	11.83	8.76	398
13082	341	367	8.21	2.29	5.86	.....	33.40	0.29	30.60	14.10	11.11	412
13220	....	252	28.28	1.72	4.86	.....	27.70	1.49	26.78	10.33	3.70	293
12604	....	....	23.10	1.95	5.22	.....	29.75	0.84	29.53	12.26	2.57	309
13088	256	256	10.30	1.89	5.46	.....	31.12	0.36	40.42	7.92	7.99	390
13079	907	940	10.53	0.75	7.28	.....	41.50	0.29	36.20	9.05	1.68	362
13092	341	357	8.59	2.35	5.06	.....	28.84	0.33	32.18	15.38	12.33	417
13085	114	96	9.91	2.20	6.08	.....	34.65	0.83	34.26	12.53	5.62	376
13089	142	210	10.47	2.55	7.20	.....	41.04	1.19	25.12	12.09	7.54	342
13090	184	175	9.18	2.04	5.06	.....	28.84	0.83	33.34	15.24	10.53	405
13072	....	213	8.49	2.47	7.86	.....	44.80	1.09	21.99	12.47	8.69	396
13081	907	908	10.81	4.26	6.64	.....	37.85	0.20	36.56	9.14	1.18	345
13221	....	209	28.85	2.42	6.31	.....	35.97	0.84	20.53	7.39	4.00	292
13222	....	234	28.49	1.83	4.73	.....	26.96	0.30	30.47	8.43	3.52	302
13074	114	87	9.32	2.73	12.12	.....	69.08	0.20	3.26	10.74	4.67	371
13219	85	101	11.00	2.22	5.74	.....	32.71	1.95	39.26	7.84	5.02	364
13075	454	461	7.65	5.39	6.42	40.13	.....	3.78	trace	24.88	18.17	424
13084	140	155	7.35	4.03	7.44	46.50	.....	1.80	10.58	14.23	15.51	421
13078	481	485	6.32	4.43	6.30	39.38	.....	4.33	1.86	25.10	18.58	433
13080	680	716	8.31	0.71	13.14	.....	74.90	0.30	3.77	10.04	1.97	373
13086	426	423	7.11	3.28	5.14	32.13	.....	0.85	21.40	9.10	26.13	486
13403	223	215	10.41	6.07	12.67	79.19	.....	....	none	3.18	1.15	340
13326	227	278	7.00	3.28	8.98	56.13	.....	0.47	1.80	5.80	25.52	485

TABLE IV.—ANALYSES OF

Station No.	Manufacturer and Brand.
	The Kellogg Food Co., Battle Creek, Mich.
13069	40% Gluten Biscuit
13067	Gluten Flour 40%
13070	Thoroughly Cooked 40% Gluten Meal
13068	Pure Gluten Biscuit
13071	Pure Gluten Meal
	Lister Bros., Inc., New York.
13094	Diabetic Flour. Self-rising
	Loeb's Diabetic Food Bakery, New York.
13054	Aereated Gluten Bread
12426	Aereated Gluten Bread
13038	Almond Chocolate Bars
13044	Diabetic Almond Macaroons
13045	Diabetic Breadsticks
13046	Diabetic Breadsticks. Almond
13042	Diabetic Butter Cookies
13039	Diabetic Chocolate
13047	Diabetic Lady Fingers
13041	Diabetic Sponge Cookies
13050	Caseine Bread
12425	Caseine Bread
13380	Caseine Breakfast Cereal
13051	Caseine Muffins
13052	Genuine Gluten Bread
13379	Gluten Breakfast Cereal
13040	Gluten Cracker Meal
13043	Gluten Noodles
13048	Gluten Zwieback
13049	Gluten Almond Zwieback
13053	Pure Gluten Flour
	Mayflower Mills, Fort Wayne, Ind.
13062	Gluten Flour
	Norton-Truax, Chicago, Ill.
13325	Diaprotein
	Pieser-Livingston Co., Chicago, Ill.
13055	Genuine Gluten Flour
	Potter & Wrightington, Boston, Mass.
13093	Diet-Ease Gluten Flour
14397	Diet-Ease Gluten Flour

DIABETIC FOODS—(*Continued*).

Station No.	Weight declared.	Weight found.	Water.	Ash.	Nitrogen.	Protein. N x 6.25.	Protein. N x 5.70.	Fiber.	N-free extract. Starch.	N-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
	gms.	gms.	%	%	%	%	%	%	%	%	%	
13069	71	85	9.55	1.24	7.18	.....	40.92	0.23	35.55	10.89	1.62	364
13067	....	....	10.10	0.63	8.28	.....	47.20	0.26	30.66	10.17	0.98	261
13070	454	457	8.50	1.38	7.54	.....	42.98	0.31	33.38	12.00	1.45	380
13068	85	153	8.33	2.04	13.75	.....	78.38	0.35	2.87	6.53	1.50	365
13071	454	480	7.73	0.92	13.88	.....	79.12	0.19	2.56	8.74	0.74	368
13094	57	62	11.53	9.44	10.93	68.31	.....	0.05	none	9.72	0.95	321
13054	28	31	9.17	1.78	8.04	.....	47.83	0.18	26.78	3.18	11.08	411
12426	....	....	7.85	1.80	7.46	.....	42.52	0.22	27.71	8.76	11.14	416
13038	....	74	4.76	3.43	2.38	14.88	.....	2.81	5.34	15.55	53.23	622
13044	....	88	5.90	4.39	4.86	30.38	.....	1.93	0.59	10.48	46.33	713
13045	....	47	9.14	2.67	6.69	41.81	.....	0.20	35.44	6.93	3.81	331
13046	....	70	7.93	2.00	6.30	39.38	.....	0.70	31.22	7.08	11.69	416
13042	....	123	8.85	3.06	5.84	36.50	.....	0.13	31.05	8.38	12.03	412
13039	....	76	4.72	3.45	2.35	14.69	.....	2.62	7.26	15.52	51.74	716
13047	....	19	8.33	4.41	7.64	47.75	.....	0.05	1.91	3.50	34.05	519
13041	....	19	8.66	4.45	7.95	49.69	.....	0.11	1.91	1.41	33.77	516
13050	....	144	40.42	4.47	6.53	40.84	.....	0.08	none	3.35	10.84	274
12425	....	....	39.73	4.35	6.57	41.05	.....	0.09	trace	3.71	11.07	323
13380	....	....	4.52	4.61	5.86	36.63	.....	....	0.70	11.02[1]	42.52	576
13051	....	100	30.82	4.89	7.32	45.74	.....	0.15	none	7.03	11.37	313
13052	227	218	32.01	1.80	4.98	.....	28.39	0.28	28.56	6.86	2.10	273
13379	160	170	4.38	2.73	5.12	.....	29.18	1.04	25.51	17.78	19.38	464
13040	....	104	8.40	1.59	6.44	.....	36.71	0.28	30.66	11.48	10.88	417
13043	85	85	10.23	1.63	6.54	.....	37.28	0.15	36.84	10.28	3.59	370
13048	....	55	9.61	1.91	6.78	.....	38.65	0.14	36.06	10.64	2.99	368
13049	....	59	8.91	1.94	6.60	41.25	.....	0.58	32.57	6.97	7.78	392
13053	454	429	10.48	0.89	6.80	.....	38.76	0.15	38.22	10.30	1.20	360
13062	....	....	10.35	0.85	8.42	.....	47.99	0.30	28.63	10.23	1.65	365
13325	265	281	11.72	6.35	12.44	77.75	.....	....	none	2.72	1.46	335
13055	....	....	10.16	0.81	7.26	.....	41.38	0.20	36.31	9.79	1.35	362
13093	....	....	12.50	0.98	4.64	.....	26.45	0.73	46.89	10.29	2.16	354
14397	....	....	8.76	0.96	6.94	.....	39.56	0.42	36.20	11.78	2.32	371

[1] Includes fiber.

TABLE IV.—ANALYSES OF

Station No.	Manufacturer and Brand.
	The Pure Gluten Food Co., Columbus, Ohio.
13215	Hoyt's Gluten Breakfast Food 40% Protein
13212	Hoyt's Gluten Flour over 40% Protein
13214	Hoyt's Gluten Granules over 40% Protein
13213	Hoyt's Gluten Self-raising (Flour) over 40% Protein
13605	Hoyt's Gluten Special Flour 80% Protein
	Schulenburg Oil Mill, Schulenburg, Texas.
13058	Baumgarten Process Allison Flour
	Still Rock Spa, Waukesha, Wis.
13352	Curdolac Flour
	Soy Bean Food Products Co., San Francisco, Calif.
13696	Soy Bean Flour A
13697	Soy Bean Flour B
	Waukesha Health Products Co., Waukesha, Wis.
13064	Hepco Dodgers
13065	Hepco Flour
13063	Hepco Grits
	Wilson Bros., Rochester, N. Y.
13056	Genteel Brand Flour
13057	Gluten Flour
	Miscellaneous.
14291	Dia-Biskit. Genevieve Jackson, Los Angeles, Calif.
13381	Svea Wafers. Prepared for S. S. Pierce Co., Boston, Mass.
13060	Peanut Butter. Acme Brand, J. W. Beardsley's Sons, Newark N. J.
13061	Peanut Butter. Beechnut Brand, Beechnut Packing Co., Canajoharie, N. Y.

DIABETIC FOODS—(*Concluded*).

Station No.	Weight declared.	Weight found.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	N-free extract.		Fat.	Calories.
						N x 6.25.	N x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
	gms.	gms.	%	%	%	%	%	%	%	%	%	
13215	454	463	9.23	0.93	8.07	.....	46.00	0.51	31.39	10.15	1.79	366
13212	454	479	10.68	0.82	7.34	.....	41.84	0.27	33.19	12.07	1.13	359
13214	454	466	9.75	0.97	7.68	.....	43.78	0.68	32.15	10.08	2.59	327
13213	454	462	10.18	3.85	7.28	.....	41.50	0.50	33.38	9.72	0.87	346
13605	454	464	6.82	1.10	13.54	.....	77.18	0.27	2.81	10.63	1.19	373
13058	5443	....	8.08	5.67	8.00	50.00	.....	3.47	1.13	21.61	10.04	381
13352	....	....	10.25	3.99	9.06	56.63	.....	3.79	5.09	17.89	2.36	335
13696	....	....	7.65	4.71	6.69	41.81	.....	1.98	0.34	24.07	19.44	440
13697	....	....	7.91	5.08	7.04	44.00	.....	2.07	0.76	25.98	14.20	411
13064	....	....	8.73	5.68	6.79	42.44	.....	3.85	1.01	21.56	16.73	411
13065	....	....	8.09	4.31	7.04	44.00	.....	2.15	0.90	21.41	19.14	438
13063	....	....	8.88	5.51	6.44	40.25	.....	4.19	0.87	23.91	16.39	408
13056	....	....	11.60	0.98	4.70	29.38	.....	0.26	49.16	6.23	2.39	361
13057	....	....	10.52	0.74	8.04	.....	45.83	0.36	28.63	11.91	2.01	364
14291	....	....	6.08	6.13	2.82	17.63	.....	11.99	6.13[2]	47.21	4.83	328
13381	50	....	10.58	2.85	1.04	6.50	.....	0.13	53.72	25.53	0.69	349
13060	....	....	1.82	3.07	5.00	31.25	.....	1.77	5.29	8.53	48.27	615
13061	....	....	1.99	3.32	4.86	30.38	.....	1.81	5.04	7.55	49.91	621

[2] Includes reducing substances derived from agar-agar.

COMMENTS ON INSPECTION AND ANALYSES.

Since the adaptability of any particular food to the diet of a diabetic patient is primarily a question of individual tolerance we do not propose to criticize the various products herein reported essentially from that standpoint except insofar as certain standards and regulations which have been formulated by Federal or other authorities may apply. We concur in the belief that a manufacturer offering a product as a diabetic food should declare its composition, within reasonable limits, for the guidance of practitioners and others interested. With reliable information as to the three essential food groups, viz., protein, fat, and carbohydrate, the physician can save himself much blind experiment in his efforts to establish a patient's tolerance.

Herman Barker's Gluten Food A is declared to contain "not over 4 per cent. carbohydrates and approximately 87 per cent. of protein"; Gluten Food B "not over 7 per cent. carbohydrates and approximately 85 per cent. of protein"; Gluten Food C "not over 12 per cent. carbohydrates and approximately 83 per cent. protein."

Our analyses show the constituents named in about the same proportion as declared in the several cases but the actual amounts stated appear to have been based upon the protein factor 6.25.

Farwell and Rhines' Gluten Flour 40 per cent. conforms to its label and to the Federal standard for gluten flour.

Golden Rod Milling Co. Acme Special Flour. We have no evidence that this product is sold specifically as a diabetic food. No analysis accompanied the sample analyzed but a tag attached thereto stated that analyses of the company's products are on file with the Dairy and Food Commissioner (of Oregon) and will be furnished by him or the Company upon application. We understand that the product has been used as a diabetic food, but it is evident that with 15 per cent. of protein and 70 per cent. of carbohydrate it could not be tolerated by any diabetic who could not also tolerate ordinary flour.

The Health Food Co. emphasizes the fact that their purpose is "to supply a diet ranging from an absolutely starchless to a full-tolerance diet," letting the physician decide upon that food or group of foods which is best adapted to the needs of his patient. Our analyses indicate that this perfectly rational plan is followed. In our opinion a statement of the limits of protein,

fat, and carbohydrate on the label of each product would be a decided advantage.

The Kellogg Food Co. The chemical composition within reasonable limits is given on the labels of the several products examined which our analyses in the main substantiate. We commend this practice. However, some of their statements with regard to the advantages of high protein in general, and wheat protein in particular, are extravagant in the light of recent investigations referred to elsewhere in this bulletin.

Lister Bros. Inc. The composition of Lister's Diabetic flour, self-raising, is adequately stated on the label. Their analysis shows 9.72 per cent. of nitrogen-free extract which is ordinarily interpreted as carbohydrate in the usual proximate analysis. As this interpretation might appear to conflict with their claim that the product is free from starch and sugar, at the manufacturers' request we have tested the flour for water-soluble carbohydrates and find only negligible amounts of copper-reducing substances present. This particular group of constituents, other than starch, is obtained by difference as already explained and it obviously includes the accumulated variations of other determinations, which, in this case and that of other similar preparations, are enhanced by losses of leavening constituents in the process of ashing.

Loeb's Diabetic Food Bakery products are without declaration of composition except that Sponge Cookies and Lady Fingers are declared to be "without flour or sugar." We find only 1.9 per cent. of starch in each of these cases and only 1.4 and 3.5 per cent. respectively of other nitrogen-free extract. Gluten Flour satisfies the Federal definition and standard for this product.

Mayflower Mills and *Pieser-Livingston Co.'s* Gluten Flours both exceed the Federal standard. The latter has a complete analysis printed on the sack which our analysis confirms when converted to the same (water-free) basis.

Norton-Truax Diaprotein, which is a casein flour, is declared to be free from starch and sugar and to contain 83 per cent. of protein. We find no starch and only 2.72 per cent. of other nitrogen-free extract, which would be lower still by the use of the protein factor 6.38, and which in any case probably contains not more than traces of copper-reducing materials. Eighty-

three per cent of protein requires about 13 per cent. of casein nitrogen. We find 12.44 per cent. of nitrogen in the material as analyzed. This discrepancy is due to a difference in moisture content; the declaration is based upon a moisture figure of 6.72 whereas we find 11.72 per cent. of moisture in the sample examined.

Potter and Wrightington. The first sample of Diet Ease Gluten Flour submitted was below standard. Apparently the manufacturers were misled by the reports of their analyst which showed the crude gluten content instead of protein based on the nitrogen content. A sample examined subsequently conformed to the Federal standard.

The Pure Gluten Food Co. Only declarations of protein, which our analyses confirm, are made on the labels of these products. Special flour 80 per cent. contains over 80 per cent. protein calculated on the water-free basis.

Schulenburg Oil Mill. Allison Flour (Cottonseed Flour) is a high-grade cottonseed product. It is practically free from starch and contains about the same amount of other carbohydrates as soy bean flour. It has been shown by Rather[1] that about 78 per cent. of the protein of cottonseed meal or flour is utilized in the metabolism of man; and that these proteins are utilized equally as well as the proteins of legumes, nine-tenths as well as those of cereals and eight-tenths as well as those of meat. As to the carbohydrates, while we know that 75 per cent. of the nitrogen-free extract is digestible by ruminant animals we do not know to what extent they are utilized in human digestion. One of the sugars present is raffinose, for the preparation of which cottonseed meal is commonly used. The low starch content and relatively low content of other carbohydrates has suggested this product as an adjunct to the diabetic diet. Knowledge of its protein-glucose yield in metabolism would be valuable in judging its suitability for this purpose.

Still Rock Spa. Curdolac Flour we understand has not yet been placed upon the open market, its use having been confined to the treatment of diabetic patients in the hospital where it originated, or of those who have been under treatment there.

Soy Bean Food Products Co., Waukesha Health Food Co., and

[1] Jour. Am. Chem. Soc. 36, p. 584, 1914.

Cereo Co. Analyses of their soy bean preparations are typical of products of their respective types. Available carbohydrates are relatively low; but the glucose yield of the proteins of the soy bean has not been determined.

Wilson Bros. We have no information that Genteel Brand Flour is recommended as a diabetic food; it requires practically as great carbohydrate tolerance as ordinary flour. Gluten Flour, however, satisfies the Federal standard for this product.

Miscellaneous Preparations. Dia-Biskit is made from washed bran and agar-agar and so labeled. The starch content is low and the carbohydrates of agar-agar are not appreciably available in human metabolism.[1] Svea Wafers, on the other hand, are very high in available carbohydrates.

No general examination of peanut butter has been attempted but the two samples submitted have been analyzed.

In general our inspection reveals an evident purpose on the part of manufacturers to maintain standards and market their products for what they are. The practice of controlling their output by chemical analysis is increasing. Inquiry generally reveals a knowledge, on their part, of the essential composition of their products; but this might, however, be better or more fully stated on the labels in many cases. Since there is no universal diabetic food, particular claims of merit for any product which might lead the patient to believe that he could safely introduce that article into his dietary should be discouraged. The production of a foodstuff of standard or declared composition, marketed under a label which adequately states what that composition is, should be the prime duty of the manufacturer, leaving the responsibility of recommending and prescribing that food to the attending physician.

SPECIAL PREPARATIONS OF INTEREST IN CONNECTION WITH DIABETIC DIETARIES.

The rigid dietary restrictions in cases of severe diabetes result in menus which are conspicuously monotonous. Since our mental attitude toward that which we eat, whether in health or disease, is now recognized as a factor in metabolism, food for the diabetic patient should be prepared with more than ordinary care as to

[1] Wardall. Jour. Am. Med. Assoc. 69, pp. 1859-62, 1917.

attractiveness and palatability. The need of greater variety in the diet is emphasized by Dr. Allen,[1] who is particularly interested in the introduction of uncommon fruits and vegetables wherever the climatic conditions permit of their culture, in the hope of finding something of interest and usefulness from this standpoint. The diet should also be adequate, not only from the quantitative point of view as represented by the calorie intake, but also from the qualitative side as represented by the important accessory diet factors or vitamines. Unfortunately the exclusion of certain types of foods by reason of their unsuitable carbohydrate content automatically excludes desirable sources of vitamines; and the modification of other types, as in the case of the thrice-cooking process, necessarily removes those essential diet principles which are soluble in water. The minimum calorie intake, which usually obtains in diabetic treatment, and the restricted range of choice in diet further reduce the possibility of adequate vitamine supply. In this connection the nutrition studies of Osborne and Mendel offer a practical suggestion. They have repeatedly demonstrated the practicability of administering vitamine concentrates to remedy natural or induced disturbances in metabolism, and the use of such preparations to supplement foods naturally low in, or artificially deprived of vitamines, and to insure a sufficient amount of these important diet factors in the low-calorie and restricted diet of the diabetic, is worthy of consideration in practical diabetic treatment.

Beyond these general suggestions we do not propose to go into the subject of diabetic menus and recipes which has been adequately treated by Joslin and others. But we have been interested in a number of preparations which clinical experience has shown to be of interest and value in the diabetic dietary. These include washed bran, thrice-cooked vegetables, diabetic broths and artificial or modified milks.

Washed Bran.

Bran is used in the diet of diabetic patients to an increasing extent. It is valuable both as an aid to digestion by reason of the bulk it adds to ingested foods and as a diluent for concentrated foods on account of its relatively low protein and limited

[1] Private communication.

availability of its carbohydrate. The glucose yield of bran in metabolism has not been established but the work of Swartz[1] and others with complex carbohydrates comparable to those of bran would suggest that its carbohydrates are not utilized to any considerable extent in human digestion.

Numerous so-called "health" brans are on the market. They are primarily for use to relieve constipation and are not generally marketed specifically as diabetic foods. However, the impression has been gained by many diabetic patients that such preparations are safe. This impression is unfortunate for, as Dr. Joslin has noted, many such brans contain more starch than the ordinary commercial bran commonly used as a fodder grain. This is illustrated in the analyses of bran given in the accompanying table.

In order to render bran suitable for use in the diabetic diet the simple process of washing it free from starch by a stream of water is recommended as a household method of treatment. The bran is placed in a cheese cloth bag and tied under the faucet, allowing a stream of water to run through it until the water comes through clear. Frequent kneading of the mass is necessary for effective washing.

This is, of course, a wasteful process and commercially the problem is approached in a different manner, the starch being first converted into soluble carbohydrate and then removed by suitable means.

For the purpose of finding the composition of bran washed by the household method outlined above and to give an idea of the comparative composition of the washed and unwashed material as well as information as to the losses involved, the following experiments were tried.

Three samples of bran were used. One, **13600**, was common bran sold as a commercial cattle feed. The others, **13601** and **13111**, were "health" brans intended for clinical use but not recommended particularly for diabetic patients.

One hundred grams of each were washed in running water until the washings were clear and gave negative or faint tests for starch by means of iodine solution. The samples were then spread out on trays, dried rapidly in a current of warm air, and

[1] Swartz, Mary D., Nutrition Investigations of the Carbohydrates of Lichens, Algae and Related Substances. Yale University Press, 1911.

the weight of the extracted and dried bran observed. The losses were found to be from 39 to 45 per cent.

Analyses of the original unwashed bran and the washed product are given in Table V. The analyses are also given on the water-free basis; and values representing the losses sustained have also been calculated.

TABLE V.—ANALYSES OF BRAN, UNWASHED AND WASHED.

Description of material.	Water.	Ash.	Protein, N. x 6.25.	Fiber.	Starch.	Total sugar.	Other nitrogen-free extract.	Fat, ether extract.
	%	%	%	%	%	%	%	%
Common bran, original unwashed, *air dry*	9.02	6.24	15.63	10.49	9.00	7.16	37.52	4.94
washed, *air dry*	4.25	4.34	14.00	15.94	2.08	0.52	54.56	4.31
original unwashed, *water free*	....	6.86	17.18	11.53	9.89	7.87	41.24	5.43
washed, *water free*	....	4.53	14.62	16.64	2.17	0.54	57.00	4.50
original constituents remaining	....	2.89	9.32	10.61	1.73		36.33	2.87
original constituents, washed away	....	3.97	7.86	0.92	16.03		4.91	2.56
Health bran, B. original unwashed, *air dry*	9.84	5.29	19.38	7.57	20.81	6.52	27.25	3.34
washed, *air dry*	4.57	5.17	21.69	13.82	6.58	0.54	43.93	3.70
original unwashed, *water free*	....	5.87	21.49	8.40	23.08	7.23	30.23	3.70
washed, *water free*	....	5.42	22.73	14.48	6.90	0.57	46.02	3.88
original constituents remaining	....	3.15	13.23	8.43	4.35		26.78	2.26
original constituents washed away	....	2.72	8.26	+0.03	25.96		3.45	1.44
Health bran, C. original unwashed, *air dry*	7.92	5.60	19.00	7.54	22.25	5.88	27.77	4.04
washed, *air dry*	3.61	7.09	22.69	11.30	8.41	0.56	41.54	4.80
original unwashed, *water free*	....	6.08	20.63	8.19	24.16	6.38	30.17	4.39
washed, *water free*	....	7.36	23.54	11.72	8.73	0.58	43.09	4.98
original constituents remaining	....	4.70	15.03	7.48	5.94		27.51	3.18
original constituents washed away	....	1.38	5.60	0.71	24.60		2.66	1.21

The analyses show that the common bran contained only about 16 per cent. of carbohydrates of the readily available types (starch and sugar), as compared with nearly 30 per cent. in the health brans.

The true comparison in composition of the unwashed and washed products is shown by their respective analyses calculated to the water-free basis. There is a conspicuous reduction in available carbohydrate but other constituents may or may not be reduced. Thus, for example, protein is higher in the unwashed material; yet considerable amounts of protein have been lost in material mechanically removed.

The actual losses sustained are estimated by calculating the analysis of the water-free washed material to the basis of the water-free unwashed material. Samples **13600, 13601** and **13111** lost 36.25, 41.80 and 36.16 per cent. respectively on washing; the respective factors are therefore 63.75, 58.20 and 63.84 on the water-free basis.

The effect of the washing in these trials was to remove from 70 to 83 per cent. of the available carbohydrate; the health brans still contained, however, between 5 and 10 per cent. of this material. Large and variable proportions of other constituents were also removed. For example, there was a loss of ash ranging from 23 to 58 per cent. and of protein ranging from 27 to 46 per cent.

The use of washed bran as a diluent for high protein flours is illustrated by the following recipes and analyses of the products made thereby.[1]

Gluten-Bran Bread:

120 cc. water
1 yeast cake
10 grams 40 per cent. gluten flour
15 grams washed bran (Sample No. 13600)
Salt
10 grams oleomargarine

Weight of loaf after baking 185 grams.

Gluten-Bran Muffins:

40 cc. water
8 grams baking powder

[1] Recipes and baked products submitted by Miss Hoffman of the Dietetic Department of the New Haven Hospital.

40 grams 80 per cent. gluten flour
20 grams washed bran (Sample No. 13600)
Salt
15 cc. cooking oil
50 grams egg

Weight of muffins (6) after baking 115 grams.

TABLE VI. ANALYSES OF GLUTEN-BRAN BREAD AND MUFFINS.

	Bread.		Muffins.	
	In air dry.	In original.	In air dry.	In original.
	%	%	%	%
Water	2.90	39.64	2.94	24.04
Ash	2.38	1.48	6.84	5.35
Nitrogen	6.49	4.03	7.20	5.63
Protein (N. x 5.7)	36.99	22.97	41.04	32.09
Fiber	2.22	1.38	3.47	2.72
Nitrogen-free Extract:				
Starch	29.93	18.60	6.50	5.09
Other N.-free Ext.	18.11	11.29	19.20	15.05
Fat	7.47	4.64	20.01	15.66

THRICE-COOKED VEGETABLES.

In many of the common vegetables the carbohydrate content s so low that they are tolerated without modification by diabetics. Vegetables which are eaten only after cooking and which are removed from the water in which they are cooked, lose considerable amounts of carbohydrate. This suggested to Allen[1] the more complete removal of carbohydrate material by repeated extraction with water which constitutes the so-called thrice-cooking process. Vegetables so treated are boiled with water, usually three times, and the water is drained off and discarded after each boiling. The number of treatments of this kind may be extended for substances particularly rich in sugar materials or in cases where such materials are slowly removed.

Wardall[2] has suggested and tried a modification of this process by which vegetables are extracted at 60° C. for periods of ten to fifteen minutes, repeating the extractions until carbohydrates are practically all removed as determined by actual reduction tests with Fehling's solution. She finds that the color, texture, and

[1] Boston Med. and Surg. Jour., p. 241, 1915.
[2] Jour. Am. Med. Assoc., 69, 1859-1862, 1917.

palatability of vegetables are less impaired by this process than by repeated treatments with boiling water, although the method is probably not adapted to the preparation of all vegetables, particularly cabbage.

Comparative analyses of cooked and uncooked vegetables are not readily available. Joslin[1] has compiled results which give comparisons from the standpoint of carbohydrate content.

TABLE VII.—CARBOHYDRATE CONTENT OF FRESH AND COOKED VEGETABLES, (JOSLIN).

	Fresh. %	Cooked. %
Asparagus	3.3	2.2
Spinach	3.2	2.6
Beans, string	7.4	1.6
Beets	9.7	7.4
Carrots	9.2	6.8
Cabbage	5.6	3.8*
Greens, beet	...	3.2
Onions	9.9	4.9
Beets, boiled	...	10.0
Parsnips	...	13.2
Peas	16.9	14.6
Potatoes	18.4	20.9
Potato chips	...	46.7
Sweet potatoes	27.4	42.1

* Loss of 33 per cent.

It is quite evident that repeated extractions with water will remove from foods nutrient materials other than sugar, particularly ash constituents and water-soluble vitamines. The loss of these accessory diet factors is the more regrettable for the reason that in the restricted diet of the diabetic it cannot be readily compensated; but the practicability of administering vitamine concentrates to correct artificial or natural dietary deficiencies has already been referred to and would appear to be a logical remedy in this instance.

The distribution of losses in the several proximate groups of nutrients has been determined by analyses of several vegetables

[1] Treatment of Diabetes Mellitus, p. 212.

both in the fresh state and after extraction by the two methods already mentioned and now given in further detail.

Extraction at low temperature was carried out as recommended by Wardall.[1]

> Place eight hundred grams of thinly sliced material in double cheesecloth and immerse in 1600 cc. of water at 60° C. for 15 minutes. Drain off the water and add a fresh portion of water at the same temperature and allow to stand 15 minutes. Repeat the decantations and additions of fresh water until the water extract gives tests with Fehling's solution which are negative or inconsiderable, both before and after hydrolysis with acid. Dry rapidly in current of warm air.

The number of extractions required to reach a practically negative test is quite variable in different cases. With rhubarb the test was insignificant after three extractions, while with asparagus eleven extractions were necessary.

The thrice-cooking process was carried out as described by Joslin.[2]

> Allow 800 grams of the finely sliced material contained in double cheesecloth to soak in cold water for 30 minutes. Drain off the water. Add 1600 cc. of cold water, bring to boiling and boil for 3 to 5 minutes. Discard the water. Repeat the operation of boiling and adding water twice more, finally rinsing with cold water and drying rapidly in current of warm air.

For the purpose of comparison, in each case a portion of untreated material was air dried under the same conditions that prevailed in case of the extracted material. The analysis of this air-dry material was converted to the basis of the original, untreated substance and a similar loss due to water assumed for the same vegetable under the different methods of extraction. The analyses of the untreated and the extracted materials show the same respective water content and therefore other variations may be attributed to the effects of extraction.

The analyses of asparagus, rhubarb and chinese cabbage are given in Table VIII. Analyses of the edible portion and of the seeds and placenta of sweet green peppers, untreated, are included.

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[1] Jour. Am. Med. Assoc., 69, 1859-1862, 1917.

[2] Treatment of Diabetes Mellitus, pp. 533-4.

TABLE VIII.—ANALYSES OF VEGETABLES, UNCOOKED, THRICE-COOKED AND EXTRACTED.

Description of material.	Water.	Ash.	Protein, N x 6.25.	Fiber.	Total sugar.	Other nitrogen-free extract.	Fat, ether extract.	Nitrogen.
	%	%	%	%	%	%	%	%
Asparagus, untreated	92.64	0.60	2.34	0.90	1.37	1.95	0.20	0.37
Extracted, Wardall method..	92.64	0.19	2.32	1.73	0.13	2.69	0.30	0.37
Thrice-cooked, Joslin method	92.64	0.23	2.36	1.68	0.18	2.56	0.35	0.38
Rhubarb, untreated	94.88	0.74	0.76	0.75	0.17	2.59	0.11	0.12
Extracted, Wardall method..	94.88	0.21	0.60	1.60	0.08	2.53	0.10	0.10
Thrice-cooked, Joslin method	94.88	0.24	0.69	2.06	0.05	1.98	0.10	0.11
Chinese cabbage, untreated	95.33	0.56	1.20	0.50	1.41	0.94	0.06	0.19
Extracted, Wardall method..	95.33	0.24	1.07	1.16	0.05	2.03	0.12	0.17
Thrice-cooked, Joslin method	95.33	0.25	1.17	1.16	0.11	1.85	0.13	0.19
Green peppers, sweet, untreated, edible portion[1]	93.81	0.36	0.83	0.82	1.85	2.23	0.10	0.13
Seeds and placenta..........	86.25	0.73	3.00	2.90	1.67	2.73	2.72	0.48

[1] Edible portion 87.2%, seeds and placenta 12.8%.

The actual losses of original solid matter in the several cases by the two methods of treatment was determined to be as follows:

	Wardall method.	Joslin method.
	%	%
Asparagus	51.5	50.8
Rhubarb	57.0	66.0
Chinese cabbage	56.7	56.7

The analyses show a very complete removal of the more readily available portion of the nitrogen-free extract, i. e., reducing sugars; and a decrease also, though less conspicuous, in what is usually reckoned as carbohydrate, in this case sugar and other nitrogen-free extract. Protein is not substantially changed but there is a notable loss of mineral matter.

BROTHS.

Joslin[1] refers to the extensive use of broths upon fasting days in the treatment of diabetes. Their composition becomes of

[1] Treatment of Diabetes Mellitus, page 271.

interest and importance on account of their utilization for this purpose. Analyses made for Dr. Joslin by Mr. A. H. Smith in Professor Mendel's laboratory, have already indicated the substance and quality of these preparations.

Nine samples of various broths prepared at the New England Deaconess Hospital and sent to us at Dr. Joslin's request have been examined and the results appear in Table IX.

TABLE IX.—ANALYSES OF BROTHS USED IN DIABETIC TREATMENT.

Station No.	Kind of Broth.	Total solids.	Fat, ether extract.	Total nitrogen.	Total reducing sugars.	Total ash.	Salt (NaCl).
		%	%	%	%	%	%
13342	Mutton bone	2.10	0.04	0.23	none	0.28	0.05
13343	Veal bone	1.42	0.04	0.23	none	0.36	0.03
13344	Beef bone	1.32	0.04	0.20	none	0.30	0.05
13345	Beef bone	0.92	0.03	0.15	none	0.32	0.03
13346	Mutton bone	0.90	0.04	0.16	none	0.18	0.03
13347	Veal bone	1.85	0.02	0.28	none	0.30	0.05
13348	Chicken	0.69	0.04	0.10	none	0.19	0.03
13349	Clams chopped	1.60	0.03	0.24	none	0.48	0.06
13391	Clams unchopped	1.93	0.04	0.20	none	0.30	0.07

It is apparent that the gross amount of nutrient material in these preparations is small, the total solids ranging generally from 1 to 2 per cent. Fat is present in traces only. They are free from available carbohydrates as indicated by negative reduction tests with Fehling's solution. Appreciable amounts of mineral constituents are present but salt is satisfactorily low. According to Joslin, salt should not exceed 0.5 per cent. Nitrogenous matter is low. Smith determined the distribution of nitrogen and found that the proportion of total nitrogen which was in the form of protein varied considerably. Summarizing his results, Joslin states that nearly three-fourths of the total nitrogen may generally be considered to be in protein and amino combination, the remainder being due to extractives.

Joslin recommends the use of thin, clear, meat broths, agree-

ably seasoned, lightly salted and free from fat and sediment. Our analyses appear to be chemically descriptive of such broths.

Artificial and Modified Milks.

Cows' milk ordinarily contains from 4.2 to 4.8 per cent. of sugar. Skimmed milk and buttermilk are not essentially different from whole milk as regards sugar content but in cream, sugar will seldom exceed 3 per cent. Unrestricted use of these products is not allowable in cases of low carbohydrate tolerance and particularly when taken in conjunction with other food. For this reason various substitutes for milk have been suggested.

Williamson[1] recommends a preparation made from cream, egg white, salt and a trace of saccharin. Joslin has used commercial sugar-free milks with success. Janney has introduced soy bean milk as a milk substitute in the treatment of diabetes in children and finds it distinctly valuable. He also writes that almond milk is being used in his clinic with marked success in certain intestinal cases.

Methods for preparing these milk substitutes, other than sugar-free milk, are as follows:

Williamson's formula (as prepared in this laboratory). To one pint of water add four tablespoonfuls of 20 per cent. cream, mix thoroughly and allow to stand for twelve hours. Remove the cream layer and add to it the beaten white of one egg. Mix well and dilute with water to the consistency of milk. (A little salt and a trace of saccharin may be added if desired.)

Janney's formula, soy bean milk. To one quart of water add five ounces of soy beans and allow to stand twelve hours. Grind through a coarse grinder, strain through four thicknesses of gauze and heat to 100° C.

Janney's formula, almond milk. Shell and blanch the almonds and put them through a fine grinder. To 500 cc. of water add 30 grams of glycerol and 250 grams of almond meal. Allow to stand over night and strain through gauze.

Analyses of these preparations are given in Table X.

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[1] Williamson. Diabetes Mellitus and Its Treatment, The Macmillan Co., 1898.

TABLE X.—ANALYSES OF MILK SUBSTITUTES.

	Williamson's Formula.	Soybean Milk.	Almond Milk.[4]	Sugar-free Milk (Whiting's).
	%	%	%	%
Solids	6.21	2.49	13.09	16.70
Ash	0.11	0.33	0.49	0.76
Protein	1.50[1]	1.38[1]	3.03[1]	6.43[2]
Sugar	0.12	0.37	1.21	0.22
Fat	4.00	0.29	2.88[3]	9.34
Glycerol	....	....	5.48	....

[1] Factor 6.25.
[2] Factor 6.38
[3] May include some glycerol.
[4] Prepared by Miss Hoffman.

COMPILATION OF ANALYSES OF DIABETIC FOODS.

Table I of our report for 1913[1] contained analyses of diabetic foods made in this laboratory previous to that time, new analyses made that year and included also some data compiled from other sources. That tabulation has now been revised and enlarged to include many analyses made by us and published in our reports since 1913, our new analyses as given in Table IV of this report, and some analyses compiled from reports of other laboratories, and constitutes Table XI of this report.

In summary Table XI is made up as follows:

Analyses from Connecticut Report, 1913	387
Analyses from Connecticut Reports since 1913	107
New analyses made in 1919	85
Analyses compiled from other sources	51
Total	630

The analyses are identified by means of marginal symbols the interpretation of which will be found in the following list of references:

SOURCES OF COMPILED ANALYSES.

1. *California Agr. Exp. Station Report,* A, 1895, p. 161; B, 1902-3, p. 88; C, 1902-3, p. 97: 2. *Connecticut Agr. Exp. Station Report,* A, 1899, p. 138; B, 1901, p. 199; C, 1903, p. 140;

[1] Conn. Exp. Sta. Report of 1913, Part I, Section 1.

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TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	FLOURS AND MEALS.
	Acme Mills Co., Portland, Ore.
1910-15	Acme Diabetic Flour
	Amthor & Co., Halle.
1904-6j	Weizen-Protein
	Herman Barker, Somerville, Mass.
1906-2e	Barker's Gluten Food "A"
1912-2m	Barker's Gluten Food "A"
1919	Barker's Gluten Food "A"
1906-2e	Barker's Gluten Food "B"
1913-2p	Barker's Gluten Food "B"
1919	Barker's Gluten Food "B"
1906-2e	Barker's Gluten Food "C"
1913-2p	Barker's Gluten Food "C"
1919	Barker's Gluten Food "C"
	Battle Creek Sanitarium Co., Battle Creek, Mich.
1916-4a	Gluten Meal
1916-4a	Gluten Meal
1914-2q	Gluten Meal 80%
	Bischof & Co., London.
1907-2g	Gluten Flour
	Callard, Stewart & Watt, London.
1906-2e	Casoid Flour
1909-3	Casoid Flour
1916-4a	Gluten Flour
	Canada Cereal & Flour Co.
1919-4b	Gluten Flour
	Cereo Co., Tappan, N. Y.
1912-2m	Soy Bean Gruel Flour
1913-2p	Soy Bean Gruel Flour
1919	Soy Bean Gruel Flour
	The Dieto Food Co., New York City.
1914-2q	Flour, Pure Whole Wheat
	Empire Flour Mills.
1919-4b	Gluten Flour

OF DIABETIC FOODS.

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
)-15	9.40	1.10	1.50	9.40	.....	0.80	71.40	6.00	1.90	364
}-6j	8.60	1.10	13.46	.....	76.70	....	12.20		1.40	368
5-2e	10.10	0.20	13.66	.....	77.90	0.00	4.50[1]	6.70	0.60	362
2-2m	7.40	0.40	13.90	.....	79.20	0.20	trace	12.30	0.50	370
)	9.86	0.29	13.50	.....	76.95	0.06	2.56	9.84	0.44	361
5-2e	10.10	0.20	13.50	.....	77.00	0.00	6.00[1]	6.10	0.60	362
3-2p	6.30	0.40	13.62	.....	75.20	0.40	3.70	13.40	0.60	375
)	9.72	0.33	12.98	.....	73.99	0.08	5.23	10.14	0.51	362
5-2e	9.70	0.20	13.20	.....	75.20	0.00	8.30[1]	5.80	0.80	364
3-2p	5.70	0.40	13.46	.....	76.70	0.60	3.40	12.60	0.60	377
)	10.00	0.42	12.79	.....	72.90	0.09	6.39	9.80	0.40	360
5-4a	7.55	1.35	4.61	.....	26.28	0.12	55.03	8.65	1.02	369
5-4a	7.35	1.20	6.90	.....	39.33	....	41.12	10.08	0.92	370
}-2q	6.83	....	13.44	.....	76.61	....	5.77	.....	.....	...
7-2g	10.10	1.30	12.77	.....	72.80	0.20	12.00		3.60	372
5-2e	10.00	2.50	13.70	85.60	.....	....	none	1.40[2]	0.50	353
)-3	10.30	2.50	13.20	82.50	.....	....	none	3.10[2]	1.60	357
5-4a	9.70	....	12.88	.....	73.40	....	none	.....	.....	...
)-4b	12.02	2.61	3.26	.....	18.58	1.50	43.87	16.94	4.48	358
2-2m	4.90	4.40	7.31	45.70	.....	1.90	0.60	22.00	20.50	458
3-2p	4.20	4.20	6.90	43.10	.....	2.20	trace	24.90	21.40	465
)	6.12	3.98	7.38	46.13	.....	2.38	0.90	21.86	18.63	443
}-2q	7.85	1.15	2.36	.....	13.45	1.01	62.44	11.99	2.11	371
)-4b	10.46	0.48	2.30	.....	13.11	0.25	59.08	15.48	1.14	3.61

Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	FLOURS AND MEALS—(*continued*).
	Farwell & Rhines, Watertown, N. Y.
1906-2e	Cresco Flour
1913-2p	Cresco Flour
1913-2p	Cresco Flour
1904-2d	Gluten Flour
1906-2e	Gluten Flour
1906-2e	Gluten Flour
1909-3	Gluten Flour
1913-2p	Gluten Flour
1913-2p	Gluten Flour
1916-4a	Gluten Flour
1916-4a	Gluten Flour
1919-4b	Gluten Flour
1919-4b	Gluten Flour
1919-4b	Gluten Flour
1919-4b	Gluten Flour 40%
1919	Genuine Gluten Flour 40%
1904-2d	Special Diabetic Food
1906-2e	Special Diabetic Food
1906-2e	Special Diabetic Food
1906-2e	Special Diabetic Food
1913-2p	Special Diabetic Food
	Gericke, Potsdam
1910-9	Aleuronat
	Golden Rod Milling Co., Portland, Ore.
1913-2p	Acme Special Flour
1919	Acme Special Flour
1916-4a	Gluten Flour
	O. B. Gilman, Boston, Mass.
1913-2p	Gluten Flour
	Karl Goldscheider, Carlsbad.
1909-3	Conalbin-Mehl No. 1
	Gumpert, Berlin.
1910-9	Ultramehl
1908-10c	Wheat Protein, **Hazard's**
	The Health Food Co., New York City.
1906-2e	Almond Meal
1913-2p	Almond Meal

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
1906-2e	12.70	0.50	1.78	11.10	.....	....	.....	74.80	0.90	352
1913-2p	12.70	0.40	2.90	18.10	.....	0.40	57.20	10.20	1.00	351
1913-2p	.....	....	3.22	20.10	.....	....	.....	.....	.....	...
1904-2d	.....	....	1.50	.....	8.55	....	much	.....	.....	...
1906-2e	12.70	0.40	1.82	.....	10.40	0.30	71.50[1]	3.80	0.90	351
1906-2e	13.30	0.50	1.73	.....	9.90	0.10	72.00[1]	3.20	1.00	349
1909-3	10.70	0.50	1.92	.....	10.90	....	77.40[2]		0.50	358
1913-2p	8.30	0.60	6.90	.....	39.30	0.20	38.10	12.30	1.20	370
1913-2p	8.60	0.50	7.41	.....	42.20	0.60	32.80	14.20	1.10	367
1916-4a	10.65	0.45	3.06	.....	17.44	0.04	63.39	7.05	0.98	360
1916-4a	7.05	0.35	7.04	.....	40.13	....	41.35	10.12	1.00	366
1919-4b	10.93	0.34	3.64	.....	20.75	trace	54.09	12.55	1.34	362
1919-4b	11.14	0.57	3.84	.....	21.89	trace	55.71	9.41	1.28	360
1919-4b	9.34	0.52	7.16	.....	40.82	trace	32.17	15.75	1.40	368
1919-4b	9.09	0.55	6.90	.....	39.32	trace	37.75	12.03	1.26	368
1919	10.65	0.75	7.10	.....	40.47	0.23	37.01	9.42	1.47	361
1904-2d	.....	....	2.16	13.50	.....	....	much	.....	.....	...
1906-2e	12.00	1.90	2.29	14.30	.....	1.40	58.30[1]	9.10	3.00	354
1906-2e	10.30	1.60	2.27	14.20	.....	1.10	62.10[1]	7.90	2.80	362
1906-2e	12.40	1.30	2.05	12.80	.....	0.60	70.30		2.60	358
1913-2p	9.60	1.80	4.40	27.50	.....	1.70	40.00	16.60	2.80	362
1910-9	9.30	0.90	13.34	.....	76.04	....	10.46[2]		3.30	376
1913-2p	10.00	0.70	2.53	15.80	.....	0.70	57.90	13.50	1.40	361
1919	11.73	1.02	2.42	15.13	.....	0.33	61.48	8.56	1.75	356
1916-4a	12.12	....	2.47	.....	14.08	....	66.97	.....	1.25	...
1913-2p	8.70	1.00	7.57	.....	43.20	0.60	31.40	13.10	2.00	369
1909-3	9.40	0.50	1.74	10.90	.....	....	78.80[2]		0.40	362
1910-9	6.60	2.90	5.84	36.50	.....	....	9.40[2]		44.60	585
1908-10c	7.00	0.60	6.69	.....	38.10	0.30	52.80		1.20	374
1906-2e	8.50	6.40	8.10	50.60	.....	2.90	7.20[1]*	8.80	15.60	407
1913-2p	7.90	6.30	8.05	50.30	.....	2.80	trace	17.90	14.80	406

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	FLOURS AND MEALS—(*continued*).
	The Health Food Co., New York City—(*continued*).
1914-2q	Almond Meal
1919	Almond Meal
1919	Bran Biskue, Gluten Bran
1911-2k	C. B. X. Cold Blast Flour, 25% Protein
1919	Diabetic Casein Flour (self-raising)
1914-2q	Gluten Flour No. 1
1916-4a	Gluten Flour
1919-4b	Gluten Flour 40%
1906-2e	Glutosac Gluten Flour
1909-3	Glutosac Gluten Flour
1911-10d	Glutosac Gluten Flour
1913-2p	Glutosac Gluten Flour
1914-2q	Glutosac Gluten Flour
1919	Glutosac Gluten Flour
1913-2p	Pronireu (Gluten Griddle Cake Flour)
1919	Pronireu (Gluten Griddle Cake Flour)
1906-2e	Protosac Gluten Flour
1913-2p	Protosac Gluten Flour
1914-2q	Protosac Gluten Flour
1913-2p	Protosoy Soy Flour
1914-2q	Protosoy Soy Flour
1919	Protosoy Soy Flour
1906-2e	Pure Washed Gluten Flour
1913-2p	Pure Washed Gluten Flour
1914-2q	Pure Washed Gluten Flour
1919	Pure Washed Gluten Flour
1919	Snow Flake Diabetic Casein Flour
	R. Hundhausen, Hamm.
1892-6j	Aleuronat (pure)
1892-6j	Aleuronat (less pure)
	Hudon Hebert (furn'r).
1919-4b	Gluten Flour
	Jireh Diabetic Food Co., New York City.
1906-2e	Diabetic Flour
1906-2e	Diabetic Flour
1919-4b	Diabetic Flour
1919-4b	Diabetic Flour
1913-2p	Flour
1919-4b	Gluten Flour
1919-4b	Gluten Flour

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
914-2q	7.16	5.48	7.86	49.13	.....	0.48	none	15.91	21.84	457
919	7.90	6.01	8.04	50.25	.....	2.40	none	18.00	15.44	412
919	9.19	3.38	4.85	.....	27.65	1.51	33.84	13.90	10.53	396
911-2k	8.70	0.50	1.62	10.10	.....	0.20	68.90	10.70	0.90	367
919	11.93	9.16	11.56	72.25	.....	0.14	none	5.73	0.79	319
914-2q	7.65	2.78	12.11	.....	69.03	0.21	7.09	12.36	0.88	362
916-4a	7.70	....	7.28	.....	41.50	....	35.00	.....	.....	...
919-4b	8.48	0.65	6.88	.....	39.21	0.35	37.27	12.99	1.05	371
906-2e	10.10	1.10	5.45	.....	31.10	1.00	49.30[1]	5.80	1.60	359
909-3	8.00	1.10	5.65	.....	32.20	....	58.10[2]		0.60	367
911-10d	8.70	....	5.86	.....	33.40	....	.....	.....	.....	...
913-2p	8.20	1.40	6.38	.....	36.40	0.70	36.90	14.10	2.30	370
914-2q	8.18	1.20	6.08	.....	34.65	0.48	41.96	11.84	1.69	369
919	10.53	0.75	7.28	.....	41.50	0.29	36.20	9.05	1.68	362
913-2p	8.80	4.90	5.97	.....	34.00	0.50	37.70	12.90	1.20	349
919	10.81	4.26	6.64	.....	37.85	0.20	36.56	9.14	1.18	345
906-2e	10.60	0.70	5.86	.....	33.40	0.30	50.00[1]	4.10	0.90	358
913-2p	8.00	0.90	6.83	.....	38.90	0.30	36.30	13.90	1.70	372
914-2q	8.16	1.30	7.35	.....	41.90	0.38	31.50	14.80	1.96	370
913-2p	3.00	5.00	6.77	42.30	.....	5.40	trace	24.50	19.80	446
914-2q	3.86	5.30	6.86	42.88	.....	2.75	1.86	24.17	19.18	448
919	6.32	4.43	6.30	39.38	.....	4.33	1.86	25.10	18.58	433
906-2e	6.20	0.80	9.98	.....	56.90	0.20	27.50[1]	7.50	0.90	376
913-2p	6.10	0.50	12.85	.....	73.20	0.40	7.00	11.20	1.60	380
914-2q	7.03	0.58	13.70	.....	78.09	0.40	2.81	10.08	1.01	373
919	8.31	0.71	13.14	.....	74.90	0.30	3.77	10.04	1.97	373
919	10.41	6.07	12.67	79.19	.....	....	none	3.18	1.15	340
892-6j	8.50	0.90	13.78	.....	78.55	....	11.55		0.50	365
892-6j	9.10	1.20	12.43	.....	70.85	0.20	17.45		1.20	364
919-4b	11.84	1.24	2.52	.....	14.36	1.30	52.20	16.84	2.22	354
906-2e	9.30	1.30	2.29	14.30	.....	1.00	66.60[1]	5.30	2.20	365
906-2e	11.00	1.30	1.94	12.10	.....	1.10	72.70		1.80	355
919-4b	10.36	1.04	2.60	.....	14.82	1.00	50.13	20.69	1.96	360
919-4b	12.03	1.01	2.49	.....	14.22	1.05	50.62	18.55	2.52	356
913-2p	7.60	1.40	2.30	14.40	.....	1.40	60.90	12.00	2.30	370
919-4b	9.10	1.40	2.52	.....	14.36	1.20	50.00	21.86	2.08	371
919-4b	11.34	1.34	2.50	.....	14.25	1.60	48.66	20.41	2.40	355

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	FLOURS AND MEALS—(*continued*).
	Jireh Diabetic Food Co., New York City—(*continued*).
1913-2p	Patent Barley
1913-2p	Patent Cotton Seed Flour
1913-2p	Patent Lentils Flour
1913-2p	Protein Flour
1913-2p	Soja Bean Flour
1906-2e	Wheat and Barley Flour
1906-2e	Wheat and Barley Flour
	Johnson Educator Food Co., Boston, Mass.
1906-2e	Educator Standard Gluten Flour
1911-2k	Educator Standard Gluten Flour
1911-10d	Educator Standard Gluten Flour
	The Kellogg Food Co., Battle Creek, Mich.
1904-11	20% Gluten Meal
1909-3	20% Gluten Meal
1912-2m	20% Gluten Meal
1916-2s	20% Gluten Meal
1906-2e	40% Gluten Flour
1906-2e	40% Gluten Flour
1909-3	40% Gluten Flour
1912-2m	40% Gluten Flour
1913-2p	40% Gluten Flour
1916-2s	40% Gluten Flour
1919	40% Gluten Flour
1909-3	40% Gluten Flour, Self-Raising
1916-2s	40% Gluten Meal
1919	40% Gluten Meal, Thoroughly Cooked
1909-3	80% Gluten
1912-2m	80% Gluten
1916-4a	Gluten Meal
1916-2s	Pure Gluten Meal
1919	Pure Gluten Meal
	Lister Bros., New York City.
1917-2t	Lister's Diabetic Flour, Self-rising
1919	Lister's Diabetic Flour, Self-rising
	Lyster Bros., Whitefield, N. H.
1915-2r	Casein Flour
1916-12a	Diabetic Flour

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
913-2p	5.00	1.10	1.82	11.40	.....	0.70	67.80	12.40	1.60	381
913-2p	7.40	5.50	7.86	49.10	.....	4.00	6.00	15.30	12.70	396
913-2p	5.90	2.50	4.37	27.30	.....	3.30	42.60	17.20	1.20	359
913-2p	7.30	1.70	5.02	31.40	.....	0.90	48.50	8.20	2.00	370
913-2p	4.40	4.60	6.77	42.30	.....	4.70	0.00	25.80	18.20	435
906-2e	9.70	1.50	1.89	11.80	.....	1.60	66.20[1]	7.30	1.90	358
906-2e	9.50	1.60	1.81	11.30	.....	1.40	74.40		1.80	359
906-2e	11.30	1.00	4.22	.....	24.10	0.40	56.80[1]	4.70	1.70	358
911-2k	7.30	0.80	6.42	.....	36.60	0.20	40.90	12.80	1.40	374
911-10d	8.80	....	6.42	.....	36.60	....	.....	.....	.....	...
904-11	10.50	1.00	2.53	.....	14.40	0.40	57.40	15.70	0.60	355
909-3	8.90	1.10	3.36	.....	19.20	....	70.00[2]		0.80	364
912-2m	9.80	1.40	4.40	.....	25.10	0.10	49.60	13.50	0.50	357
916-2s	7.65	1.22	4.33	.....	24.68	0.12	51.24	14.17	0.92	369
906-2e	10.50	0.50	6.45	.....	36.80	0.20	46.90[1]	3.90	1.20	361
906-2e	8.50	1.40	6.14	.....	35.00	0.10	50.00[1]	3.80	1.20	366
909-3	7.90	1.20	6.24	.....	35.60	....	53.50[2]		1.80	373
912-2m	9.70	1.40	7.52	.....	42.90	0.20	31.90	13.00	0.90	359
913-2p	8.00	1.20	6.99	.....	39.80	0.20	40.50	9.40	0.90	367
916-2s	8.62	0.89	5.90	.....	33.63	0.08	48.04	7.31	1.43	369
919	10.10	0.63	8.28	.....	47.20	0.26	30.66	10.17	0.98	261
909-3	8.80	1.30	6.19	.....	35.30	....	53.60[2]		1.00	365
916-2s	7.30	1.36	7.29	.....	41.55	0.10	36.59	11.99	1.11	371
919	8.50	1.38	7.54	.....	42.98	0.31	33.38	12.00	1.45	380
909-3	7.20	0.60	12.61	.....	71.90	....	19.40[2]		0.90	373
912-2m	9.10	0.60	13.01	.....	74.20	0.20	6.20	8.80	0.90	365
916-4a	5.10	0.45	12.90	.....	73.53	0.18	3.10	15.88	1.76	386
916-2s	4.60	0.96	13.47	.....	76.78	0.08	6.77	10.00	0.81	374
919	7.73	0.92	13.88	.....	79.12	0.19	2.56	8.74	0.74	368
917-2t	11.62	2.77	10.78	67.38	.....	0.17	none	17.20	0.86	346
919	11.53	9.44	10.93	68.31	.....	0.05	none	9.72	0.95	321
915-2r	5.70	5.78	13.52	84.50	.....	0.05	none	0.37	3.60	381
916-12a	6.58	7.90	12.68	79.25	.....	....	none*	.....	3.00	...

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	FLOURS AND MEALS—(*continued*).
	Eugene Loeb, New York City.
1913-2p	Gluten Cracker Meal ....
1913-2p	Imported Gluten Flour ....
1913-2p	Pure Gluten Flour ....
1913-2p	Whole Wheat Flour ....
	E. Loeb & Co., New York City.
1913-2p	Gluten Flour ....
1919-4b	Gluten Flour ....
	Loeb's Diabetic Food Bakery, New York City.
1916-2s	Gluten Cracker Meal ....
1919	Gluten Cracker Meal ....
1919-4b	Gluten Cracker Meal ....
1916-2s	Pure Gluten Flour ....
1919	Pure Gluten Flour ....
	Thos. Martindale & Co., Philadelphia, Pa.
1913-2p	Special Gluten Flour ....
	Maple Leaf Milling Co.
1919-4b	Gluten Flour ....
	Mayflower Mills, Fort Wayne, Ind.
1913-2p	Bond's Diabetic Flour ....
1919	Gluten Flour ....
	A. McFarlane Co.
1919-4b	Gluten Flour ....
	P. McIntosh Co.
1919-4b	Gluten Flour ....
	Theo. Metcalf Co., Boston, Mass.
1906-2e	Soja Bean Meal, 5.5% Starch ....
1906-2e	Soja Bean Meal, 7.6% Starch ....
1913-2p	Soja Bean Meal, 18.0% Starch ....
1906-2e	Vegetable Gluten, 20.0% Starch ....
1913-2p	Vegetable Gluten, 8.1% Starch ....
	H. Niemöller, Gütersloh.
1901-16	Roborat ....

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
13-2p	9.70	1.00	4.45	.....	25.40	0.30	40.20	15.70	7.70	394
13-2p	9.20	1.40	12.21	.....	69.60	0.40	4.40	14.10	0.90	361
13-2p	10.10	0.60	6.45	.....	36.80	0.30	39.60	10.20	2.40	368
13-2p	11.10	1.10	2.34	.....	13.30	0.50	54.60	17.20	2.20	360
13-2p	9.80	0.50	7.02	.....	40.00	0.30	39.80	8.50	1.10	363
19-4b	9.72	0.48	6.12	.....	34.86	0.20	39.87	14.11	0.76	362
16-2s	8.22	1.07	6.82	.....	38.87	0.19	31.59	11.14	8.92	407
19	8.40	1.59	6.44	.....	36.71	0.28	30.66	11.48	10.88	417
19-4b	7.94	1.39	6.46	.....	36.82	0.30	32.17	12.43	8.95	406
16-2s	8.85	0.51	7.65	.....	43.61	0.13	35.78	10.11	1.01	333
19	10.48	0.89	6.80	.....	38.76	0.15	38.22	10.30	1.20	360
13-2p	8.20	0.60	6.45	.....	36.80	0.30	41.40	11.20	1.50	371
19-4b	12.52	0.38	2.22	.....	12.66	0.25	61.51	11.52	1.16	353
13-2p	9.40	0.60	6.43	40.20	.....	0.20	40.60	7.70	1.30	366
19	10.35	0.85	8.42	.....	47.99	0.30	28.63	10.23	1.65	365
19-4b	11.09	0.47	2.16	.....	12.14	0.30	60.34	14.28	1.38	358
19-4b	10.65	0.45	2.64	.....	15.05	0.25	63.28	9.32	1.00	360
06-2e	7.80	4.40	6.38	39.90	.....	3.90	9.00[1]	15.90	19.10	431
06-2e	.....	....	5.89	36.80	.....	....	.....	.....	.....	...
13-2p	6.50	4.10	6.56	41.00	.....	3.40	25.00		20.00	444
06-2e	7.90	0.70	9.82	.....	56.00	0.30	26.80[1]	6.70	1.60	372
13-2p	7.60	0.50	12.86	.....	73.30	0.20	5.90	11.00	1.50	374
01-16	9.50	1.40	13.17	82.30	.....	0.20	2.90		3.70	374

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	FLOURS AND MEALS—(*continued*).
	North Western Cereal Co., London, Ont.
1916-4a	Gluten Flour
1916-4a	Gluten Flour
1916-4a	Gluten Flour
1919-4b	Gluten Flour
1916-4a	Gluten Flour
1919-4b	Gluten Flour, 40%
	Norton-Truax, Chicago, Ill.
1919	Diaprotein
	Phospho Food Co., Los Angeles, Calif.
1914-2q	Phospho D. & D. Special
	Pieser-Livingston Co., Chicago, Ill.
1913-2p	Gluten Flour
1913-2p	Gluten Flour
1919	Genuine Gluten Flour
	Potter & Wrightington, Boston, Mass.
1919	Diet-Ease Gluten Flour
1919	Diet-Ease Gluten Flour
	The Pure Gluten Food Co., New York City.
1904-2d	Gum Gluten Flour
1911-2k	Gum Gluten Flour
1902-1b	Gum Gluten Ground
1904-11	Gum Gluten Ground
1906-2e	Gum Gluten Ground
1902-1b	Gum Gluten Self Raising
1906-2e	Gum Gluten Self Raising
1906-2e	Hoyt's Gum Gluten
1914-2q	Hoyt's Gum Gluten Flour, 50%
1914-2q	Hoyt's Gum Gluten Flour, Ground
1914-2q	Hoyt's Gum Gluten Self Raising Flour
1914-2q	Hoyt's Gum Gluten Special Flour
1901-10b	Plain Gluten Flour
1911-10d	Pure Gluten Flour
1911-10d	Pure Gluten Flour
	Pure Gluten Food Co., Columbus, Ohio.
1919	Hoyt's Gluten Flour over 40% Protein
1919	Hoyt's Gluten Self-raising Flour over 40% Protein
1919	Hoyt's Gluten Special Flour 80% Protein

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
6-4a	8.50	....	2.07	.....	11.80	....	60.60	.....	.....	...
6-4a	11.10	....	2.42	.....	13.79	....	54.68	.....	.....	...
6-4a	9.30	....	2.03	.....	11.57	....	53.20	.....	.....	...
9-4b	10.21	2.10	2.99	.....	17.07	1.58	42.10	21.95	4.99	369
6-4a	12.77	....	1.78	.....	10.14	....	64.80	.....	2.02	...
9-4b	11.66	2.27	2.49	.....	14.20	2.40	38.65	25.56	5.26	361
9	11.72	6.35	12.44	77.75	....	....	none	2.72	1.46	335
4-2q	8.74	1.22	2.19	13.69	.....	1.24	58.57	14.35	2.19	366
3-2p	8.50	0.60	6.93	.....	39.50	0.10	38.40	11.60	1.30	370
3-2p	8.70	0.60	6.69	.....	38.10	0.20	36.50	14.50	1.40	369
9	10.16	0.81	7.26	.....	41.38	0.20	36.31	9.79	1.35	362
9	12.50	0.98	4.64	.....	26.45	0.73	46.89	10.29	2.16	354
9	8.76	0.96	6.94	.....	39.56	0.42	36.20	11.78	2.32	371
4-2d	.....	....	8.69	.....	49.53	....	.....	.....	.....	...
1-2k	8.10	1.00	6.13	.....	34.90	0.20	42.40	11.80	1.60	371
2-1b	11.90	0.90	4.29	.....	24.50	....	61.30[2]		1.40	356
4-11	10.60	0.80	7.05	.....	40.20	0.40	30.00	16.70	1.30	359
6-2e	6.90	1.00	8.02	.....	45.70	0.50	38.60[1]	5.40	1.90	376
2-1b	9.80	3.80	5.04	.....	28.70	0.30	56.00		1.40	351
6-2e	10.80	4.50	6.06	.....	34.50	0.50	42.90[1]	5.80	1.00	342
6-2e	11.20	1.00	5.09	.....	29.00	0.30	52.00[1]	4.90	1.60	358
4-2q	6.61	0.70	7.95	.....	45.32	0.33	37.07	8.82	1.15	375
4-2q	8.21	0.60	6.71	.....	38.24	0.18	42.61	9.23	0.93	369
4-2q	7.30	3.88	6.83	.....	38.93	0.40	38.98	9.76	0.75	357
4-2q	5.63	0.93	14.51	.....	82.70	0.35	2.17	7.50	0.72	376
1-10b	9.90	0.60	8.58	.....	48.90	0.20	34.50		5.90	363
1-10d	.....	....	6.06	.....	34.54	....	.....	.....	.....	...
1-10d	9.10	....	6.29	.....	35.54	....	.....	.....	.....	...
9	10.68	0.82	7.34	.....	41.84	0.27	33.19	12.07	1.13	359
9	10.18	3.85	7.28	.....	41.50	0.50	33.38[*]	9.72	0.87	346
9	6.82	1.10	13.54	.....	77.18	0.27	2.81	10.63	1.19	373

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	FLOURS AND MEALS—(*continued*).
	Rademann's Nährmittelfabrik, Frankfurt.
1913-2p	Diabetiker Mehl
	Ralston Health Food Co.
1895-1a	Gluten Flour
1902-1b	Gluten Flour
	Schulenburg Oil Mill, Schulenburg, Texas.
1915-2r	Allison's Cotton Seed Flour
1919	Baumgarten Process Allison Flour
	Soy Bean Food Products Co., San Francisco, Calif.
1919	Soy Bean Flour A
1919	Soy Bean Flour B
	Sprague, Warner & Co., Chicago, Ill.
1913-2p	Richelieu Gluten Flour
	Still Rock Spa, Waukesha, Wis.
1919	Curdolac Flour
	G. Van Abbott & Sons, London.
1913-2p	Almond Flour
1913-2p	Gluten Flour
1913-2p	Gluten Semola
	Waukesha Health Products Co., Waukesha, Wis.
1917-2t	Ayos, the Improved Soja Bean Flour
1914-12b	Hepco Flour
1919	Hepco Flour
	White Swan Spice Co., Toronto.
1916-4a	Diet Flour
1916-4a	Diet Flour
1919-4b	Diet Flour
1919-4b	Gluten Flour
1919-4b	Gluten Flour
1919-4b	Gluten Flour
	Wilson Bros., Rochester, N. Y.
1919	Genteel Brand Flour
1911-10d	Gluten Flour, 4/7 Standard
1911-10d	Gluten Flour, 4/7 Standard
1913-2p	Gluten Flour, 4/7 Standard
1913-2p	Gluten Flour, Self-Raising, 4/7 Standard
1919	Gluten Flour

OF DIABETIC FOODS—(*Continued*).

	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
·2p	9.60	0.80	6.06	37.90	.....	0.20	46.80	3.90	0.80	362
·1a	12.80	0.60	2.40	.....	13.70	0.60	70.30		2.00	354
·1b	11.90	0.90	2.53	.....	14.40	....	72.30[2]		0.50	351
·2r	9.38	5.95	8.06	50.38	.....	2.70	1.07	19.28	11.24	384
	8.08	5.67	8.00	50.00	.....	3.47	1.13	21.61	10.04	381
	7.65	4.71	6.69	41.81	.....	1.98	0.34	24.07	19.44	440
	7.91	5.08	7.04	44.00	.....	2.07	0.76	25.98	14.20	411
2p	8.70	0.50	7.95	.....	45.30	0.20	31.60	12.50	1.20	368
	10.25	3.99	9.06	56.63	.....	3.79	5.09	17.89	2.36	335
2p	4.00	3.00	3.94	24.60	.....	1.90	none	7.90	58.60	657
2p	10.20	0.80	12.02	.....	68.50	0.40	12.40	6.80	0.90	359
2p	10.10	2.80	8.22	.....	46.90	0.40	28.20	8.70	2.90	361
2t	8.75	4.13	6.63	41.44	.....	3.82	0.56	24.43	16.87	458
12b	6.96	5.05	6.72	42.00	.....	5.05	none	23.82[3]	17.12	417
	8.09	4.31	7.04	44.00	.....	2.15	0.90	21.41	19.14	438
4a	10.20	....	2.06	12.90	.....	....	60.75	.....	.....	...
4a	11.25	0.90	1.65	10.30	.....	0.10	67.84	7.95	1.66	359
4b	11.47	0.70	1.52	.....	8.66	0.55	61.29	16.05	1.28	356
4b	9.21	0.77	1.72	.....	9.80	0.44	62.30	16.00	1.48	370
4b	10.50	0.75	1.56	.....	8.89	0.46	62.00	15.95	1.45	360
4b	10.84	0.87	1.61	.....	9.18	0.44	61.60	15.47	1.60	359
	11.60	0.98	4.70	29.38	.....	0.26	49.16	6.23	2.39	361
10d	11.10	....	3.18	.....	18.10	....	.....	.....	.....	...
10d	9.70	....	3.12	.....	17.80	....	.....	.....	.....	...
2p	11.00	1.20	3.33	.....	19.00	0.30	54.60	11.80	2.10	361
2p	12.20	4.60	2.78	.....	15.80	0.30	51.80	13.30	2.00	342
	10.52	0.74	8.04	.....	45.83	0.36	28.63	11.91	2.01	364

ıcludes fiber. [3] Includes soluble carbohydrates calculated as sugar 9.02 per cent.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	PROTEIN PREPARATIONS.
	The Bauer Chemical Co., Berlin.
1912-2n	Sanatogen
	Eiweiss Extrakt Co., Altona, Germany.
1900-6g	Soson
	Krecke & Co., Salzuflen.
1902-6i	Energin
	Menley & James, New York City.
1913-2p	Glidine
	Plasmon Co., London.
1899-6i	Plasmon (average 9 analyses)
1901-10b	Plasmon
1908-2h	Plasmon
1909-3	Plasmon
	Troponwerke, Mülheim.
1898-6g	Tropon (average of many analyses)
1901-10b	Tropon
	SOFT BREADS.
	Canada Bread Co., Toronto, Canada.
1919-4b	Gluten Bread
	The Dieto Food Co., New York City.
1914-2q	Dieto Bread, Pure Whole Wheat
	Ferguson Bakery, Boston, Mass.
1913-2p	Gluten Bread
	Frank & Co., Bockenheim.
1892-6f	Proteïn-Roggenbrot
1892-6f	Proteïn-Weizenbrot
	Fritz, Vienna.
....-6c	Aleuronatbrot
1910-5	Kleberbrot, Schwarz
1910-5	Litonbrot
	Fromm & Co., Dresden.
1910-5	Conglutinbrot
1910-5	Litonbrot

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
2-2n	10.00	5.60	12.82	80.10	.....	....	4.20[2]		0.10	338
o-6g	6.40	1.00	14.59	91.20	.....	....	1.10[2]		0.30	372
2-6i	9.10	1.00	13.41	83.80	.....	0.30	1.30		4.50	381
3-2p	5.70	0.90	14.62	.....	83.30	0.20	none	9.10	0.80	377
9-6i	11.90	7.50	11.23	.....	64.00	....	15.90[2]		0.70	326
1-10b	8.50	7.40	12.00	.....	68.40	....	15.50[2]		0.20	337
8-2h	12.40	7.70	11.25	.....	64.10	....	15.40[2]		0.40	322
9-3	10.90	7.60	12.59	.....	70.10	....	8.70[2]		2.70	339
8-6g	9.30	1.20	13.86	86.60	.....	....	2.70[2]		0.20	359
1-10b	9.20	0.80	14.16	88.50	.....	....	1.20[2]		0.30	362
9-4b	35.00	2.34	1.73	.....	9.87	0.34	34.82	16.52	1.11	255
4-2q	40.42	1.69	1.55	.....	8.84	0.71	36.57	11.41	0.36	231
3-2p	37.20	1.70	3.87	.....	22.10	0.20	25.20	10.50	3.10	259
2-6f	32.00	2.80	3.79	.....	21.60	2.30	35.10		6.20	283
2-6f	31.90	2.70	3.74	.....	21.30	2.20	45.60		6.30	284
.-6c	35.50	1.30	2.50	.....	14.30	0.20	47.90		0.80	256
o-5	.....	....	3.44	.....	19.60	....	50.50		.....	...
o-5	.....	....	6.18	38.60	.....	....	15.40		.....	...
o-5	.....	....	2.93	18.30	.....	....	47.30		.....	...
o-5	.....	....	5.73	35.80	.....	....	14.30		.....	...

[2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	PROTEIN PREPARATIONS.
	The Bauer Chemical Co., Berlin.
1912-2n	Sanatogen
	Eiweiss Extrakt Co., Altona, Germany.
1900-6g	Soson
	Krecke & Co., Salzuflen.
1902-6i	Energin
	Menley & James, New York City.
1913-2p	Glidine
	Plasmon Co., London.
1899-6i	Plasmon (average 9 analyses)
1901-10b	Plasmon
1908-2h	Plasmon
1909-3	Plasmon
	Troponwerke, Mülheim.
1898-6g	Tropon (average of many analyses)
1901-10b	Tropon
	SOFT BREADS.
	Canada Bread Co., Toronto, Canada.
1919-4b	Gluten Bread
	The Dieto Food Co., New York City.
1914-2q	Dieto Bread, Pure Whole Wheat
	Ferguson Bakery, Boston, Mass.
1913-2p	Gluten Bread
	Frank & Co., Bockenheim.
1892-6f	Proteïn-Roggenbrot
1892-6f	Proteïn-Weizenbrot
	Fritz, Vienna.
....-6c	Aleuronatbrot
1910-5	Kleberbrot, Schwarz
1910-5	Litonbrot
	Fromm & Co., Dresden.
1910-5	Conglutinbrot
1910-5	Litonbrot

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
:2-2n	10.00	5.60	12.82	80.10	.....	....	4.20[2]		0.10	338
)0-6g	6.40	1.00	14.59	91.20	.....	....	1.10[2]		0.30	372
)2-6i	9.10	1.00	13.41	83.80	.....	0.30	1.30		4.50	381
:3-2p	5.70	0.90	14.62	.....	83.30	0.20	none	9.10	0.80	377
)9-6i	11.90	7.50	11.23	.....	64.00	....	15.90[2]		0.70	326
)1-10b	8.50	7.40	12.00	.....	68.40	....	15.50[2]		0.20	337
)8-2h	12.40	7.70	11.25	.....	64.10	....	15.40[2]		0.40	322
)9-3	10.90	7.60	12.59	.....	70.10	....	8.70[2]		2.70	339
)8-6g	9.30	1.20	13.86	86.60	.....	....	2.70[2]		0.20	359
)1-10b	9.20	0.80	14.16	88.50	.....	....	1.20[2]		0.30	362
9-4b	35.00	2.34	1.73	.....	9.87	0.34	34.82	16.52	1.11	255
4-2q	40.42	1.69	1.55	.....	8.84	0.71	36.57	11.41	0.36	231
3-2p	37.20	1.70	3.87	.....	22.10	0.20	25.20	10.50	3.10	259
2-6f	32.00	2.80	3.79	.....	21.60	2.30	35.10		6.20	283
2-6f	31.90	2.70	3.74	.....	21.30	2.20	45.60		6.30	284
.-6c	35.50	1.30	2.50	.....	14.30	0.20	47.90		0.80	256
0-5	.....	....	3.44	.....	19.60	....	50.50		.....	...
0-5	.....	....	6.18	38.60	.....	....	15.40		.....	...
0-5	.....	....	2.93	18.30	.....	....	47.30		.....	...
0-5	.....	....	5.73	35.80	.....	....	14.30		.....	...

Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	SOFT BREADS—(*continued*).
	Gericke, Potsdam.
1910-5	Doppel-Porterbrot
1910-9	Doppel-Porterbrot
1910-9	Dreifach-Porterbrot
1910-9	Einfach-Porterbrot
1910-9	Sifarbrot
	Karl Goldscheider, Carlsbad.
1910-9	Sinamylbrot
	Gumpert, Berlin.
1910-9	Diabetiker-Doppel-Schwarzbrot
1910-9	Diabetiker-Doppel-Schwarzbrot
1910-9	Diabetiker-Doppel-Weissbrot
1910-9	Einfach-Schwarzbrot
1910-9	Einfach-Weissbrot
1910-9	Ultrabrot
	F. Günther, Frankfurt.
1892-6d	Kleberbrot
	Health Food Co., New York City.
1906-2e	Glutosac Bread
1914-2q	Glutosac Bread
1919	Glutosac Bread
1919-2u	Glutosac Bread
1906-2e	Protosac Bread
1914-2q	Protosac Bread
1919	Protosac Bread, No. 1
1919	Protosac Bread, No. 2
	J. Heinbockel & Co., Baltimore, Md.
1914-2q	Diabeto Bread for Diabetes
	R. Hundhausen, Hamm.
1892-6a	Aleuronatbrot, low gluten
	Jireh Diabetic Food Co., New York City.
1906-2e	Whole Wheat Bread
1913-2p	Whole Wheat Bread (not fresh)
	Eugen Loeb, New York City.
1913-2p	P. & L. Genuine Gluten Bread
	Loeb's Diabetic Food Bakery, New York City.
1919	Caseine Bread
1919-2u	Caseine Bread

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
0-5	38.60	....	4.30	26.90	.....	....	35.10		.....	...
0-9	38.90	1.10	3.50	21.90	.....	....	36.60[2]		1.50	248
0-9	35.10	1.30	4.91	30.70	.....	0.40	19.80	6.20	6.50	285
0-9	30.50	1.60	2.85	17.80	.....	....	48.30[2]		1.80	280
0-9	39.60	2.20	5.97	37.30	.....	0.60	12.30	2.70	5.30	257
0-9	39.10	3.50	4.51	28.20	.....	4.40	17.30	2.90	4.60	235
0-9	27.90	1.60	2.54	15.90	.....	0.50	39.40	2.60	11.80	348
0-9	25.60	1.60	2.96	18.50	.....	....	41.90[2]		12.70	346
0-9	23.70	2.30	3.01	18.80	.....	0.40	36.80	2.60	15.40	371
0-9	30.10	1.40	2.50	15.60	.....	....	49.50[2]		3.40	291
0-9	29.40	1.50	2.59	16.20	.....	....	46.40[2]		6.50	309
0-9	27.90	3.10	4.51	28.20	.....	0.80	6.80	1.00	32.20	434
2-6d	33.70	2.40	2.75	.....	15.68	0.70	47.02		0.50	255
6-2e	31.50	1.90	4.38	.....	24.40	0.40	29.90[1]	9.20	2.70	278
4-2q	37.20	1.64	4.34	.....	24.74	0.82	22.17	11.33	2.10	252
9	28.28	1.72	4.86	.....	27.70	1.49	26.78	10.33	3.70	293
9-2u	23.10	1.95	5.22	.....	29.75	0.84	29.53	12.26	2.57	309
6-2e	27.30	1.40	5.20	.....	29.60	0.20	33.10[1]	6.80	1.60	292
4-2q	30.70	2.11	4.77	.....	27.19	0.38	27.66	10.16	1.80	276
9	28.85	2.42	6.31	.....	35.97	0.84	20.53	7.39	4.00	292
9	28.49	1.83	4.73	.....	26.96	0.30	30.47	8.43	3.52	302
4-2q	33.47	3.22	1.37	8.55	.....	1.15	40.39	11.73	1.49	256
2-6a	39.60	1.60	2.77	.....	15.80	0.60	42.10		0.30	234
6-2e	39.20	1.80	1.50	.....	8.60	0.60	43.80[1]	5.60	0.40	236
3-2p	21.80	2.50	1.98	.....	11.30	0.60	44.90	18.20	0.70	304
3-2p	31.40	1.60	1.66	.....	9.50	0.30	44.20	10.40	2.60	280
9	40.42	4.47	6.53	40.84	.....	0.08	none	3.35	10.84	274
9-2u	39.73	4.35	6.57	41.05	.....	0.09	trace	3.71	11.07	323

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	SOFT BREADS—(*continued*).
	Loeb's Diabetic Food Bakery, New York City—(*continued*).
1919	Caseine Muffins
1916-2s	Genuine Gluten Bread
1919	Genuine Gluten Bread
1914-2q	P. & L. Genuine Glubetic Bread
	Lyster Bros., Whitefield, N. H.
1915-2r	Casein Bread
	Rademann's Nährmittelfabrik, Frankfurt.
1910-9	Diabetiker-Grahambrot
1910-5	Diabetiker-Schwarzbrot (dry)
1910-9	Diabetiker-Schwarzbrot
1910-9	Diabetiker-Schwarzbrot
1910-5	Diabetiker-Weissbrot (dry)
1910-9	Diabetiker-Weissbrot
1910-5	"D-K" Brot (dry)
1892-6f	Erdnuss-Brot
1910-9	Litonbrot
	Schelte, Münster.
1894-6b	Aleuronatbrot
	Seidl, München.
1910-5	Aleuronatbrot
1910-5	Kleberbrot
	Slinn-Shouldis Co.
1919-4b	Gluten Bread
	Troponwerke, Mülheim.
1899-8	Tropon-Brot
	Weston Bakery, Boston, Mass.
1915-2r	Gluten Bread
	HARD BREADS AND BAKERY PRODUCTS.
	James Aird.
1916-4a	Gluten Bread
	Bichof & Co., London.
1907-2g	Diabetic Glrten Bread
1907-2g	Essentiel Bread for Super Alimentation

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
19	30.82	4.89	7.32	45.74	.....	0.15	none	7.03	11.37	313
16-2s	27.72	1.51	5.66	.....	32.26	0.21	26.37	11.76	0.17	282
19	32.01	1.80	4.98	.....	28.39	0.28	28.56	6.86	2.10	273
14-2q	30.07	1.06	6.20	.....	35.34	0.36	19.15	9.97	4.05	294
15-2r	38.27	4.24	5.85	36.57	.....	0.05	none	2.49	18.38	322
10-9	31.70	1.80	1.57	9.80	.....	2.10	45.60	3.90	5.10	283
10-5	.....	....	6.05	37.80	.....	....	33.30		.....	...
10-9	29.10	1.90	2.32	14.50	.....	1.40	45.80	4.80	2.50	283
10-9	33.60	1.90	2.38	14.90	.....	....	47.70[2]		1.90	267
10-5	.....	....	6.94	43.40	.....	....	28.10		.....	...
10-9	33.80	1.90	3.73	23.30	.....	0.40	37.00	3.10	0.50	258
10-5	.....	....	1.97	12.30	.....	....	58.90		.....	...
92-6f	24.60	3.80	5.38	33.60	.....	5.50	19.70		12.80	328
10-9	42.60	2.40	4.83	30.20	.....	0.70	17.50	4.10	2.50	230
94-6b	38.80	1.30	2.93	.....	16.70	0.90	41.70		0.60	239
10-5	28.00	....	3.50	.....	20.00	....	49.20		0.30	280
10-5	24.20	....	2.98	.....	17.00	....	56.00		0.70	298
19-4b	35.00	0.69	1.62	.....	9.20	0.17	39.00	13.36	2.58	269
99-8	42.10	....	3.12	19.50	.....	....	.....	.....	.....	...
15-2r	.....	....	3.34	.....	19.04	....	28.16	.....	.....	...
16-4a	8.10	2.05	2.25	.....	13.13	0.70	59.75	15.91	0.72	360
07-2g	7.40	4.70	11.70	.....	66.70	0.00	20.70		0.50	354
07-2g	7.30	4.80	4.26	26.60	.....	0.10	59.60		1.60	359

[2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).
	Brusson Jeune, Villemur, France.
1910-2j	Gluten Bread ....
1912-2m	Gluten Bread ....
	Callard, Stewart & Watt, London.
1909-3	Almond Biscuit, Plain ....
1909-3	Almond Shortbreads ....
1916-4a	Casoid Biscuits ....
1906-2e	Casoid Biscuits, No. 1 ....
1909-3	Casoid Biscuits, No. 1 ....
1913-2p	Casoid Biscuits, No. 1 ....
1908-2i	Casoid Biscuits, No. 2 ....
1909-3	Casoid Biscuits, No. 2 ....
1908-2i	Casoid Biscuits, No. 3 ....
1909-3	Casoid Biscuits, No. 3 ....
1908-2i	Casoid Dinner Rolls ....
1909-3	Casoid Dinner Rolls ....
1909-3	Casoid Lunch Biscuit ....
1909-3	Casoid Rusk ....
1909-3	Cocoanut Biscuit + Saccharin ....
1909-3	Ginger Biscuit + Saccharin ....
1909-3	Kalari Batons ....
1913-2p	Kalari Batons ....
1909-3	Kalari Biscuits ....
1909-3	Prolactic Biscuits ....
	Canada Bread Co., Toronto, Canada.
1916-4a	Gluten Health Bread ....
	The Dieto Food Co., New York City.
1914-2q	Dieto Crackers ....
1914-2q	Dieto Rusks ....
	Frank & Co., Bockenheim.
1892-6f	Erdnuss-Kakes ....
	Fritz, Vienna.
1910-5	Braunes Luftbrot "B" ....
1910-5	Mandelbrot ....
	Fromm & Co., Dresden.
1913-2p	Almond-form Wafers with Chocolate ....
1913-2p	Butterbrezeln ....
1914-2q	Conglutin Drops ....

OF DIABETIC FOODS—*(Continued)*.

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
0-2j	7.80	1.10	5.14	.....	29.30	0.20	49.80	10.00	1.80	373
2-2m	12.70	0.80	5.97	.....	34.00	0.30	40.10	10.30	1.80	354
9-3	3.70	3.20	4.53	28.30	.....	....	36.80[2]		28.00	512
9-3	4.20	3.50	3.12	19.50	.....	....	20.70[2]		52.10	630
6-4a	7.52	....	8.99	56.18	.....	....	trace	.....	27.10	...
6-2e	7.80	3.90	10.08	63.00	.....	....	8.10[1]	.....	17.30	440
9-3	7.20	2.50	10.37	64.80	.....	....	8.70[2]		16.80	445
3-2p	4.80	3.40	10.69	66.80	.....	0.40	4.00	1.80	18.80	460
8-2i	.....	....	9.30	58.10	.....	....	0.00	.....	.....	...
9-3	7.50	3.60	9.25	57.80	.....	....	5.60[2]		25.50	483
8-2i	.....	....	8.75	54.70	.....	....	trace	.....	.....	...
9-3	7.90	5.00	8.69	54.30	.....	....	7.80[2]		25.00	473
8-2i	.....	....	12.93	80.80	.....	....	3.30[1]	.....	.....	...
9-3	7.00	1.80	12.48	78.00	.....	....	2.10[2]		11.10	420
9-3	4.20	3.80	4.08	25.50	.....	....	21.60[2]		44.90	593
9-3	5.40	4.50	5.92	37.00	.....	....	20.80[2]		32.30	522
9-3	2.60	3.10	2.66	16.60	.....	....	16.40[2]		61.30	684
9-3	2.50	3.70	2.74	17.10	.....	....	18.10[2]		58.60	668
9-3	8.10	4.40	8.46	52.90	.....	....	0.90[2]		33.70	519
3-2p	4.50	5.20	6.91	43.20	.....	0.70	none	7.40	39.00	553
9-3	6.30	3.70	9.10	56.90	.....	....	1.70[2]		31.40	517
9-3	6.30	4.00	6.86	42.90	.....	....	19.30[2]		27.50	496
6-4a	7.45	1.95	2.70	.....	15.39	0.78	57.88	13.19	3.36	376
4-2q	6.59	1.75	1.98	13.38	.....	0.98	54.84	13.92	9.24	409
4-2q	6.43	1.50	2.55	15.94	.....	0.98	52.09	13.95	9.11	410
2-6f	6.40	2.70	5.15	32.20	.....	3.10	36.50		19.10	447
0-5	.....	....	6.82	42.60	.....	....	19.80		.....	...
0-5	.....	....	2.46	15.40	.....	....	23.10		.....	...
3-2p	2.60	1.00	0.77	4.80	.....	0.30	14.00	48.30	29.00	529
3-2p	6.30	2.00	1.97	12.30	.....	0.20	43.10	19.60	16.50	449
4-2q	6.49	5.23	8.13	50.81	.....	0.23	29.19	6.94	1.11	358

Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).
	Fromm & Co., Dresden—(*continued*).
1914-2q	Conglutin-Zwieback
1913-2p	Crackers
1913-2p	Eierbiscuit
1910-5	Eiweissbrot
1913-2p	Hazelnuss-Stangen
1913-2p	Luft Bread
1913-2p	Makronen
1913-2p	Salz-Stangen
1913-2p	Stangenin
1910-5	Uni Bread
1913-2p	Uni Bread
	Gericke, Potsdam.
1910-5	Doppel-Porterzwieback
1910-9	Doppel-Porterzwieback
1910-5	Mandelbrot
1910-5	Porterbiskuits
1910-5	Porterzwieback
1910-5	Sifarbiskuits
	Karl Goldscheider, Karlsbad.
1914-2q	Aleuronat-Conglutin Cakes
1914-2q	Butter-Brezeln
1914-2q	Feinste Cocosnuss-Biskuits für Diabetiker "3.6% carbohydrates"
1914-2q	Feinste Vanille-Biskuits für Diabetiker, "3.6% carbohydrates"
1914-2q	Honigküchen für Diabetiker, "3.6% carbohydrates"
1914-2q	Saccharin-Oblaten ohne Zucker
1914-2q	Tee-Gebäck
1914-2q	Zwieback
	Groetzsch, Frankfurt.
1910-9	Diabetiker-Salzbrezch
1910-9	Diabetiker-Salzbrezch
1910-9	Pfeffernüsse
1910-9	Pfeffernüsse
	Gumpert, Berlin.
1910-9	Diabetiker-Stangen
1910-9	Doppel-Diabetiker-Zwieback
	F. Gunther, Frankfurt.
1892-6d	Aleuronat-Kåkes
1892-6d	Aleuronat-Kakes
1897-6e	Aleuronat-Kakes

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
14-2q	4.48	2.00	2.28	14.25	.....	0.40	29.70	27.92	21.25	479
13-2p	7.40	3.40	2.06	12.90	.....	0.20	58.20	10.20	7.70	395
13-2p	7.70	1.30	3.01	18.80	.....	0.20	37.50	23.10	11.40	420
10-5	.....	....	7.28	45.50	.....	....	37.50		.....	...
13-2p	5.20	2.90	2.14	13.40	.....	1.70	none	60.80	16.00	441
13-2p	8.30	8.90	8.14	50.90	.....	0.20	23.40	7.30	1.00	335
13-2p	6.00	3.00	2.26	14.10	.....	1.30	none	56.20	19.40	456
13-2p	6.20	3.60	2.08	13.00	.....	0.40	39.10	22.10	15.60	437
13-2p	6.60	1.60	2.24	14.00	.....	0.40	51.60	12.80	13.00	431
10-5	.....	....	11.41	71.30	.....	....	8.60		.....	...
13-2p	8.10	5.60	11.47	71.70	.....	3.50	2.90	6.50	1.70	340
10-5	.....	....	3.06	19.10	.....	....	41.00		.....	...
10-9	4.90	1.70	5.47	34.20	.....	....	39.70[2]		19.50	471
10-5	.....	....	2.59	16.20	.....	....	43.30		.....	...
10-5	.....	....	2.58	16.10	.....	....	63.00		.....	...
10-5	.....	....	4.22	26.40	.....	....	72.00		.....	...
10-5	.....	....	3.23	20.20	.....	....	35.30		.....	...
14-2q	5.17	1.25	4.26	26.63	.....	0.08	31.67	19.63	15.57	452
14-2q	5.16	1.83	1.68	10.50	.....	0.08	43.93	23.64	14.86	446
14-2q	2.71	2.73	5.50	34.44	.....	0.88	0.00	13.86	45.38	602
14-2q	3.14	2.85	7.42	46.38	.....	0.55	none	16.75	30.33	525
14-2q	2.98	3.05	6.45	40.31	.....	1.00	none	13.91	38.75	566
14-2q	5.42	2.43	2.64	16.50	.....	1.95	33.47	17.63	22.60	474
14-2q	3.44	1.28	1.12	7.00	.....	0.23	18.00	42.79	27.26	517
14-2q	6.85	2.70	3.41	21.31	.....	0.23	51.69	13.61	3.61	379
10-9	14.00	3.30	5.81	36.30	.....	....	17.10[2]		29.30	477
10-9	5.30	1.60	5.52	34.50	.....	0.30	22.90		35.40	548
10-9	25.20	2.80	6.19	38.70	.....	....	9.30[2]		24.00	408
10-9	15.20	2.60	6.27	39.20	.....	0.70	10.30		32.00	486
10-9	5.50	2.90	4.98	31.10	.....	....	11.00[2]		49.50	614
10-9	4.60	2.50	5.20	32.50	.....	0.80	27.10	0.40	32.10	529
92-6d	5.10	0.80	2.38	.....	13.60	0.40	70.80		9.30	421
92-6d	4.50	1.60	2.85	.....	16.30	0.90	68.80		7.90	412
97-6e	4.50	1.50	2.45	.....	14.00	....	71.30[2]		8.70	420

[2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).
	Health Food Co., New York City.
1919	Alpha
1913-2p	Alpha Best Diabetic Wafer
1914-2q	Alpha Best Diabetic Wafer
1919	Alpha No. 1 Best Diabetic Wafer, Casein
1919	Alpha No. 2 Best Diabetic Wafer
1906-2e	Diabetic Biscuit
1913-2p	Diabetic Biscuit
1914-2q	Diabetic Biscuit
1919	Gluten Cracker Dust
1913-2p	Gluten Nuggets
1914-2q	Gluten Nuggets
1919	Gluten Nuggets
1906-2e	Glutona
1919	Glutona Bread Sticks
1906-2e	Glutosac Butter Wafers
1914-2q	Glutosac Butter Wafers
1919	Glutosac Butter Wafers
1906-2e	Glutosac Rusks
1914-2q	Glutosac Rusks
1919	Glutosac Rusks
1906-2e	Glutosac Wafers, Plain
1914-2q	Glutosac Wafers, Plain
1919	Glutosac Wafers, Plain
1906-2e	Glutosac Zwieback
1914-2q	Glutosac Zwieback
1919	Glutosac Zwieback
1906-2e	No. 1 Proto Puffs
1913-2p	No. 1 Proto Puffs
1914-2q	No. 1 Proto Puffs
1919	No. 1 Proto Puffs
1911-2k	No. 2 Proto Puffs
1913-2p	No. 2 Proto Puffs
1914-2q	No. 2 Proto Puffs
1906-2e	Protosac Rusk
1914-2q	Protosac Rusk
1919	Protosac Rusk
1913-2p	Protosoy Diabetic Wafer
1914-2q	Protosoy Diabetic Wafer
1919	Protosoy Diabetic Wafer
1906-2e	Salvia Almond Sticks
1914-2q	Salvia Almond Sticks
1919	Salvia Almond Sticks

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
19	9.48	5.76	10.97	68.56	.....	0.35	1.01	6.40	8.44	380
13-2p	4.90	3.60	10.58	66.10	.....	0.50	trace	11.30	13.60	432
14-2q	7.61	5.03	10.73	67.06	.....	0.16	1.26	10.47	8.41	391
19	6.81	6.23	7.74	48.38	.....	0.17	none	4.89	33.52	515
19	12.88	5.09	11.28	70.50	.....	0.13	1.13	6.25	4.02	348
06-2e	4.70	3.10	4.50	28.10	.....	0.30	51.10[1]	13.70	9.00	413
13-2p	8.90	2.50	4.00	25.00	.....	0.20	46.50	7.70	9.20	400
14-2q	5.80	2.55	5.75	35.94	.....	0.35	39.77	6.76	8.83	409
19	8.58	2.42	7.81	.....	44.52	0.71	23.18	11.83	8.76	398
13-2p	5.70	2.80	4.83	.....	27.50	0.20	38.60	12.40	12.80	429
14-2q	5.32	2.75	5.07	.....	28.90	0.27	34.93	13.53	14.30	438
19	8.59	2.35	5.06	.....	28.84	0.33	32.18	15.38	12.33	417
06-2e	4.80	2.50	3.38	.....	19.30	0.30	54.90[1]	6.40	11.80	429
19	8.21	2.29	5.86	.....	33.40	0.29	30.60	14.10	11.11	412
06-2e	4.70	3.80	4.42	.....	25.20	1.60	41.20[1]	10.60	12.90	424
14-2q	5.44	2.10	4.98	.....	28.39	0.38	38.93	10.82	13.94	438
19	10.30	1.89	5.46	.....	31.12	0.36	40.42	7.92	7.99	390
06-2e	4.50	2.70	5.84	.....	33.30	0.90	42.50[1]	12.30	3.80	387
14-2q	6.66	2.50	6.29	.....	35.85	1.13	33.64	16.78	3.44	376
19	9.91	2.20	6.08	.....	34.65	0.83	34.26	12.53	5.62	376
06-2e	6.10	3.50	4.70	.....	26.80	1.50	41.60[1]	10.90	9.60	404
14-2q	7.24	2.55	6.82	.....	38.87	1.58	29.55	18.47	1.74	363
19	10.47	2.55	7.20	.....	41.04	1.19	25.12	12.09	7.54	342
06-2e	7.60	2.50	5.20	.....	29.60	1.20	40.90[1]	11.30	6.90	389
14-2q	5.92	2.50	5.82	.....	33.17	0.85	32.46	17.39	7.71	401
19	9.18	2.04	5.06	.....	28.84	0.83	33.34	15.24	10.53	405
06-2e	8.60	1.30	12.14	.....	69.20	0.10	9.90[1]	9.90	1.00	365
13-2p	7.20	2.70	12.21	.....	69.60	0.20	4.30	13.10	2.90	374
14-2q	8.71	2.80	11.56	.....	65.89	0.40	9.23	10.15	2.82	366
19	9.32	2.73	12.12	.....	69.08	0.20	3.26	10.74	4.67	371
11-2k	8.20	1.80	8.38	.....	47.80	0.20	27.20	13.30	1.50	367
13-2p	7.90	2.50	9.06	....	51.60	0.20	19.00	16.70	2.10	368
14-2q	9.16	2.60	9.40	.....	53.58	0.40	20.70	11.47	2.09	362
06-2e	5.90	2.00	6.54	.....	37.30	0.50	43.90[1]	8.40	2.00	376
14-2q	7.21	2.93	6.35	.....	36.19	0.48	35.89	14.30	3.00	373
19	11.00	2.22	5.74	.....	32.71	1.95	39.26	7.84	5.02	364
13-2p	3.90	5.00	6.90	43.10	.....	1.90	4.70	16.50	24.90	481
14-2q	4.76	3.50	5.93	37.07	.....	1.80	14.40	14.94	23.53	477
19	7.35	4.03	7.44	46.50	.....	1.80	10.58	14.23	15.51	421
06-2e	6.60	7.50	6.27	39.20	.....	1.90	18.70[1]	5.30	20.80	440
14-2q	2.63	3.38	3.57	22.31	.....	0.70	28.29	12.75	29.94	523
19	7.11	3.28	5.14	32.13	.....	0.85	21.40	9.10	26.13	486

[1] Includes water-soluble carbohydrates.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).
	Heintz Food Co., Chicago, Ill.
1912-13b	Gluten Biscuits
1913-2p	Gluten Biscuits
1913-2p	Glutin Biscuits
	Ch. Heudebert, Paris.
1914-2q	Pain d'Aleurone pour Diabétiques, "5% carbohydrates"
1914-2q	Pain "Essentiel" en Biscottes
1914-2q	Pain de Gluten pour Diabétiques
	R. Hundhausen, Hamm.
1892-6k	Aleuronatzwieback, high gluten
1892-6k	Aleuronatzwieback, low gluten
1894-6b	Aleuronat-Biskuits
1891-6b	Aleuronat-Kakes.
	Huntley & Palmer, London.
1912-2m	Akoll Biscuits
1913-2p	Akoll Biscuits
1916-2s	Akoll Biscuits
	Jireh Diabetic Food Co., New York City.
1906-2e	Diabetic Biscuits
1906-2e	Diabetic Biscuits
1913-2p	Diabetic Biscuits
1906-2e	Diabetic Rusks
1913-2p	Diabetic Rusks
1906-2e	Wheat Nuts
1906-2e	Wheat Nuts
	Johnson Educator Food Co., Boston, Mass.
1906-2e	Almond Biscuits
1906-2e	Diabetic Biscuits
1906-2e	Educator Crackers, Greseni Gluten
1913-2p	Educator Gluten Bread Sticks
1911-2k	Gluten Cookies
1919-4b	Gluten Cookies
1906-2e	Gluten Rusk, Greseni Gluten
1906-2e	Gluten Wafers
1906-2e	Glutine, Greseni Gluten
1899-10a	Glutine, Greseni Gluten
	The Kellogg Food Co., Battle Creek, Mich.
1912-2m	Avena-Gluten Biscuit
1906-2e	Potato Gluten Biscuit

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
12-13b	.....	....	2.10	.....	11.97	....	.....	.....	.....	...
13-2p	6.40	3.50	2.05	.....	11.70	1.30	21.40	37.40	18.30	447
13-2p	7.30	3.00	2.32	.....	13.20	1.00	45.50	22.80	7.20	391
14-2q	8.18	4.43	12.17	.....	69.21	0.71	4.22	11.80	1.45	354
14-2q	7.67	2.33	4.22	26.38	.....	0.20	49.89	12.33	1.20	365
14-2q	7.85	3.96	12.90	.....	73.53	0.16	3.38	10.28	0.84	356
92-6k	8.50	2.60	10.59	.....	60.40	....	23.50[2]		5.00	381
92-6k	6.50	1.60	3.66	.....	20.90	0.80	61.60		8.60	407
94-6b	6.60	4.70	3.97	.....	22.60	0.50	54.40		11.20	409
91-6b	3.40	1.10	3.22	.....	18.40	1.20	66.50		9.40	424
912-2m	9.30	3.90	8.51	53.20	.....	0.40	trace	6.30	26.90	480
913-2p	7.20	3.40	8.72	54.50	.....	0.70	trace	6.80	27.40	492
916-2s	7.97	3.43	8.57	53.56	.....	0.49	trace	6.22	28.33	493
906-2e	6.30	2.00	2.37	14.80	.....	0.90	65.40[1]	6.90	3.70	382
906-2e	8.90	2.30	2.10	13.10	.....	1.20	70.60		3.90	370
913-2p	5.40	2.00	2.11	13.20	....	1.20	49.60	21.20	7.40	403
906-2e	8.70	3.10	2.34	14.60	.....	0.90	67.70		5.00	374
913-2p	5.40	1.90	2.38	14.90	.....	1.10	47.00	21.00	8.70	410
906-2e	7.60	2.30	3.04	19.00	.....	1.00	50.10[1]	4.40	15.60	434
906-2e	6.00	3.20	3.36	21.00	.....	1.20	46.30		22.30	470
906-2e	5.30	2.10	4.64	29.00	.....	0.50	50.00[1]	4.30	8.80	412
906-2e	5.90	1.90	4.05	25.30	.....	0.40	54.90[1]	4.10	7.50	405
1906-2e	6.20	2.90	3.68	.....	21.00	0.20	57.90[1]	7.20	4.60	386
1913-2p	8.40	2.40	5.74	.....	32.70	0.30	37.50	11.50	7.20	392
1911-2k	4.80	2.70	4.22	.....	24.10	0.30	37.80	14.30	16.00	449
1919-4b	5.94	3.16	5.08	.....	28.96	0.40	36.49	13.45	11.60	422
1906-2e	6.20	3.00	3.54	.....	20.20	0.30	63.30[1]	6.70	0.30	364
1906-2e	6.90	0.90	4.85	.....	27.60	0.30	57.00[1]	6.90	0.40	370
1906-2e	6.40	2.60	3.50	.....	20.00	0.40	63.10[1]	6.50	0.80	366
1899-10a	10.20	1.10	2.21	.....	12.60	....	75.20[2]		0.90	359
1912-2m	7.90	2.10	3.42	.....	19.50	0.40	41.10	16.30	12.70	422
1906-2e	8.20	0.80	12.80	.....	73.00	0.00	9.80[1]	7.80	0.40	366

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).
	The Kellogg Food Co, Battle Creek, Mich.—(*continued*).
1909-3	Potato Gluten Biscuit
1913-2p	Potato Gluten Biscuit
1906-2e	Pure Gluten Biscuit
1909-3	Pure Gluten Biscuit
1916-2s	Pure Gluten Biscuit
1919	Pure Gluten Biscuit
1913-2p	Taro-Gluten Biscuits
1906-2e	40% Gluten Biscuit
1909-3	40% Gluten Biscuit
1911-2k	40% Gluten Biscuit
1912-2m	40% Gluten Biscuit
1913-2p	40% Gluten Biscuit
1916-2s	40% Gluten Biscuit
1919	40% Gluten Biscuit
1912-2m	80% Gluten Biscuit
	Kirche, Düsseldorf.
1895-6b	Aleuronat-Kakes
	Klopfer Chemische Fabrik, Dresden.
1910-9	Glidinebrot
	Eugene Loeb, New York City.
1913-2p	Gluten Luft Bread
	Loeb's Diabetic Food Bakery, New York City.
1919	Aereated Gluten Bread
1914-2q	Diabetic Almond Macaroons
1916-2s	Diabetic Almond Macaroons
1919	Diabetic Almond Macaroons
1914-2q	Diabetic Bread Sticks
1916-2s	Diabetic Bread Sticks
1919	Diabetic Bread Sticks
1919-4b	Diabetic Bread Sticks
1919	Diabetic Bread Sticks, Almond
1916-2s	Diabetic Butter Cookies
1916-2s	Diabetic Butter Cookies
1919	Diabetic Butter Cookies
1914-2q	Diabetic Lady Fingers
1916-2s	Diabetic Lady Fingers
1919	Diabetic Lady Fingers
1914-2q	Diabetic Sponge Cookies
1916-2s	Diabetic Sponge Cookies

of Diabetic Foods—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
1909-3	7.60	0.90	12.10	.....	69.00	....	19.90[2]		2.60	379
1913-2p	8.80	0.80	6.64	.....	37.90	0.40	39.50	12.10	0.50	363
1906-2e	7.50	1.00	12.85	.....	73.20	0.20	9.10[1]	8.20	0.80	369
1909-3	8.20	1.10	7.73	.....	44.10	....	43.30[2]		3.30	379
1916-2s	8.30	2.04	12.96	.....	73.87	0.12	4.02	10.82	0.83	362
1919	8.33	2.04	13.75	.....	78.38	0.35	2.87	6.53	1.50	365
1913-2p	9.40	0.70	5.01	.....	28.60	0.40	48.20	12.20	0.50	361
1906-2e	7.50	1.60	5.73	.....	32.70	0.10	52.60[1]	4.50	1.00	368
1909-3	7.50	1.40	5.82	.....	33.20	....	55.10[2]		2.80	378
1911-2k	8.00	1.60	6.93	.....	40.40	0.20	35.30	13.30	1.20	367
1912-2m	10.20	0.50	7.60	.....	43.30	0.20	35.00	10.30	0.50	359
1913-2p	7.20	1.30	5.95	.....	31.90	0.30	45.00	13.50	0.80	369
1916-2s	8.50	1.48	7.22	.....	41.15	0.08	36.98	10.83	0.98	365
1919	9.55	1.24	7.18	.....	40.92	0.23	35.55	10.89	1.62	364
1912-2m	10.10	2.10	13.18	.....	75.10	0.10	4.70	7.00	0.90	355
1895-6b	5.00	0.90	2.72	.....	15.50	1.60	63.30		13.70	439
1910-9	12.70	2.30	7.62	.....	43.40	0.30	32.80	6.30	2.20	350
1913-2p	7.30	1.00	4.46	.....	25.40	0.40	44.10	12.60	9.20	411
1919	9.17	1.78	8.04	.....	47.83	0.18	26.78	3.18	11.08	411
1914-2q	3.22	2.98	7.44	46.50	.....	1.53	0.64	7.36	37.77	558
1916-2s	4.55	4.01	5.48	34.25	.....	1.72	trace	10.46	45.01	584
1919	5.90	4.39	4.86	30.38	.....	1.93	0.59	10.48	46.33	713
1914-2q	8.72	2.28	8.07	50.44	.....	0.60	24.64	9.88	3.44	371
1916-2s	8.15	2.87	7.41	46.31	.....	0.19	35.02	7.17	0.29	339
1919	9.14	2.67	6.69	41.81	.....	0.20	35.44	6.93	3.81	331
1919-4b	7.99	3.87	6.72	42.00	.....	0.15	35.23	10.32	0.44	314
1919	7.93	2.00	6.30	39.38	.....	0.70	31.22	7.08	11.69	416
1916-2s	6.14	2.22	6.29	39.31	.....	0.15	32.18	5.07	14.93	471
1916-2s	4.07	2.86	5.02	31.38	.....	0.35	30.66	8.39	22.29	482
1919	8.85	3.06	5.84	36.50	.....	0.13	31.05	8.38	12.03	412
1914-2q	6.01	2.75	9.05	56.56	.....	0.35	1.81	4.23	28.29	505
1916-2s	5.97	3.46	7.68	48.00	.....	0.07	2.14	7.57	32.79	527
1919	8.33	4.41	7.64	47.75	.....	0.05	1.91	3.50	34.05	519
1914-2q	6.92	2.75	8.75	54.69	.....	0.55	1.24	3.74	30.11	510
1916-2s	5.82	3.49	7.14	44.63	.....	0.23	1.91	6.75	37.17	548

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).
	Loeb's Diabetic Food Bakery, New York City—(*continued*
1919	Diabetic Sponge Cookies
1919-2u	Gluten Bread
1914-2q	Gluten Luft Bread
1916-2s	Gluten Luft Bread
1916-2s	Gluten Zwieback
1915-2r	Gluten Zwieback
1919	Gluten Zwieback
1915-2r	Gluten Almond Zwieback
1916-2s	Gluten Almond Zwieback
1919	Gluten Almond Zwieback
	Gustav Müller & Co., Agent, New York City.
1913-2p	Charasse Biscuits Croquettes au Gluten
1913-2p	Charasse Biscottes Lucullus
1913-2p	Charasse Gluten Exquis Biscuits aux Amandes
1913-2p	Charasse Gluten Fleur de Neige Pain
1913-2p	Charasse Mignonettes au Gluten
1913-2p	Charasse Pain de Gluten
1913-2p	Charasse Tranches Grilles pour Potage
	Nasmith's Ltd., Toronto.
1916-4a	Diabetic Bread
	Pure Gluten Food Co., New York City.
1914-2q	No. 1 Dainty Fluffs
1914-2q	No. 2 Dainty Fluffs
1916-4a	Dainty Fluffs
1913-2p	Gum Gluten Biscuit Crisps
1914-2q	Gum Gluten Biscuit Crisps
	Rademann's Nährmittelfabrik, Frankfurt.
1893-6f	Diabetiker-Biscuits
1913-2p	Diabetiker-Biscuits
1913-2p	Diabetiker-Bretzel
1910-5	Diabetiker-Cakes
1913-2p	Diabetiker-Cakes
1893-6b	Diabetiker-Chokolade-Biskuits
1913-2p	Diabetiker-Dessert-Gebäck
1910-5	Diabetiker-Makronen
1910-9	Diabetiker-Makronen
1913-2p	Diabetiker-Makronen
1910-5	Diabetiker-Stangen
1910-9	Diabetiker-Stangen
1913-2p	Diabetiker-Stangen

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
19	8.66	4.45	7.95	49.69	.....	0.11	1.91	1.41	33.77	516
19-2u	7.85	1.80	7.46	.....	42.52	0.22	27.71	8.76	11.14	416
14-2q	5.68	2.05	8.38	.....	47.77	0.63	22.89	7.74	13.24	433
16-2s	7.05	1.20	7.12	.....	40.58	0.18	29.93	11.28	9.78	415
16-2s	8.27	2.34	7.27	.....	41.44	0.20	35.72	9.64	2.39	369
15-2r	8.39	1.45	7.47	.....	42.58	0.18	23.43	10.52	13.45	427
19	9.61	1.91	6.78	.....	38.65	0.14	36.06	10.64	2.99	368
15-2r	7.84	2.38	6.81	42.56	.....	0.60	19.13	6.90	20.59	620
16-2s	8.04	1.97	7.04	44.00	.....	0.33	33.10	6.46	6.10	389
19	8.91	1.94	6.60	41.25	.....	0.58	32.57	6.97	7.78	392
13-2p	7.30	0.50	5.49	.....	31.30	0.20	30.60	14.70	5.40	395
13-2p	7.50	1.80	1.82	11.40	.....	0.20	59.20	14.20	5.70	391
13-2p	5.30	1.60	2.90	.....	16.50	0.60	25.50	26.70	23.80	489
13-2p	6.10	2.30	5.74	.....	32.70	0.40	25.10	20.90	12.50	427
13-2p	8.20	2.10	6.42	.....	36.60	0.30	27.30	19.80	5.70	386
13-2p	8.10	2.10	6.53	.....	37.20	0.20	27.20	19.90	5.30	385
13-2p	7.70	2.30	6.50	40.60	.....	0.30	28.80	16.70	3.60	377
16-4a	8.15	1.75	1.82	11.38	.....	....	63.71	13.77	1.24	331
14-2q	7.04	0.75	12.79	79.94	.....	0.45	10.74	0.54	0.54	370
14-2q	7.45	0.68	10.60	66.25	.....	0.28	21.85	3.02	0.47	369
16-4a	7.15	1.25	12.81	80.04	.....	0.12	7.65	2.97	0.82	370
13-2p	5.30	1.70	6.86	.....	39.10	0.90	39.30	13.00	0.70	372
14-2q	5.97	1.70	8.43	.....	48.05	1.08	31.22	11.46	0.52	368
93-6f	2.90	3.50	7.06	44.10	.....	....	10.00	9.70	29.80	523
13-2p	5.00	1.10	4.74	29.60	.....	0.20	25.90	18.60	19.60	473
13-2p	6.80	3.00	5.02	31.40	.....	0.20	40.70	9.40	8.50	402
10-5	.....	....	2.02	12.60	.....	....	39.80		.....	...
13-2p	6.50	3.00	4.74	29.60	.....	0.20	39.10	8.10	13.50	429
93-6b	1.80	3.80	7.18	44.90	.....	....	11.80	10.10	27.60	516
13-2p	4.30	2.50	3.55	22.20	.....	1.10	5.90	21.60	42.40	580
10-5	.....	....	1.97	12.30	....	....	11.30		.....	...
10-9	4.50	3.20	3.57	22.30	.....	1.10	8.80	12.10	48.00	605
13-2p	4.00	3.00	3.71	23.20	.....	1.20	3.00	17.60	48.00	607
10-5	.....	....	3.63	22.70	.....	....	17.00		.....	...
10-9	10.50	2.10	4.77	29.80	.....	....	24.60[2]		33.00	515
13-2p	4.50	3.60	2.83	17.70	.....	0.50	21.40	8.10	44.20	586

[2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	HARD BREADS AND BAKERY PRODUCTS—(*continued*).
	Rademann's Nährmittelfabrik, Frankfurt—(*continued*).
1910-5	Diabetiker-Zwieback
1910-9	Diabetiker-Zwieback
1893-6b	Erdnuss-Biskuits
1910-9	Käsestangen
1913-2p	Käsestangen
1910-5	Sanitätszwieback
	Schelle, Braunschweig.
1897-6e	Aleronat-Kakes
	Seidl, München.
1910-5	Kleberzwieback
	James Strachen.
1916-4a	Gluten Bread
	Roman Uhl, Karlsbad.
1913-2p	Carlsbad-Water Biscuits, "Sprudel" Brand
	G. Van Abbott & Sons, London.
1913-2p	Caraway Biscuits for Diabetics
1913-2p	Diabetic Rusks for Diabetics
1913-2p	Euthenia Biscuits
1913-2p	Gluten Biscottes or Rolls
1913-2p	Gluten Bread or Slices
1913-2p	Gluten Butter Biscuits for Diabetics
1913-2p	Ginger Biscuits for Diabetics
1913-2p	Midolia Biscuits
1913-2p	Walnut Biscuits for Diabetics
	Waukesha Health Products Co., Waukesha, Wis.
1919	Hepco Dodgers
	Weston's Bakery, Boston, Mass.
1915-2r	Gluten Cookies
	BREAKFAST FOODS.
	Brusson Jeune, Villenur, France.
1913-2p	Farine au Gluten
1910-2j	Gluten Semolina
	Dieto Food Co., New York City.
1914-2q	Dieto Nut Cereal
1914-2q	Wheat and Barley Cereal

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
910-5	.....	....	2.62	16.40	.....	....	37.60		.....	...
910-9	9.40	2.20	4.03	25.20	.....	....	47.00	4.30[2]	11.90	413
893-6b	1.90	2.70	5.57	34.80	.....	....	9.00	30.10	21.50	489
910-9	6.90	2.20	1.79	11.20	.....	....	50.49[2]		29.30	511
913-2p	6.70	3.80	1.49	9.30	.....	0.10	38.00	8.40	33.70	524
910-5	.....	....	2.80	17.50	.....	....	58.40		.....	...
897-6e	4.90	1.30	3.18	.....	18.10	....	64.90[2]		10.80	429
910-5	6.30	....	2.37	.....	13.50	....	67.90		7.80	396
916-4a	6.20	2.20	2.96	.....	16.87	0.10	52.74	21.29	0.60	369
913-2p	8.10	1.70	1.60	10.00	.....	0.20	55.60	19.20	5.20	386
913-2p	6.70	3.60	5.70	35.60	.....	0.70	8.60	7.30	37.50	544
913-2p	10.80	1.20	11.34	70.90	.....	0.30	12.60	3.40	0.80	355
913-2p	5.50	3.40	5.73	35.80	.....	1.40	6.90	6.30	40.70	562
913-2p	10.50	2.40	8.26	.....	47.10	0.20	29.80	7.70	2.30	359
913-2p	10.60	2.00	8.66	.....	49.40	0.20	27.40	8.20	2.20	361
913-2p	6.10	3.00	7.06	.....	40.20	0.90	9.00	7.60	33.20	526
913-2p	4.10	3.40	5.54	34.60	.....	1.80	10.90	5.80	39.40	560
913-2p	6.00	4.30	2.82	17.60	.....	4.10	13.40	18.20	36.40	524
913-2p	4.40	2.90	3.34	20.90	.....	2.30	trace	12.30	57.20	648
919	8.73	5.68	6.79	42.44	.....	3.85	1.01	21.56	16.73	411
915-2r	.....	....	4.86	.....	27.70	....	19.59	.....	.....	...
913-2p	10.90	0.60	5.42	.....	30.90	0.20	48.80	8.00	0.60	356
910-2j	9.70	0.70	2.75	.....	15.70	0.30	64.90	8.20	0.50	360
914-2q	5.00	1.95	3.46	21.63	.....	1.22	39.54	12.28	18.38	459
914-2q	6.77	1.68	1.86	11.63	.....	2.00	61.42	14.35	2.15	359

[2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	BREAKFAST FOODS—(*continued*).
	Farwell & Rhines, Watertown, N. Y.
1913-2p	Barley Crystals
1913-2p	Cresco Grits
	William Hazard Co., New York City.
1908-10c	Hazard's Wheat Protein Breakfast Food
	Health Food Co., New York City.
1913-2p	Manana
1914-2q	Manana Gluten Breakfast Food
1919	Manana Gluten Breakfast Food
1919	Protosoy (Cereal)
	Jireh Diabetic Food Co., New York City.
1913-2p	Whole Wheat Farina
1913-2p	Frumenty
	Kellogg Food Co., Battle Creek, Mich.
1911-2k	Granola
	Loeb's Diabetic Food Bakery, New York City.
1919	Caseine Breakfast Cereal
1919	Gluten Breakfast Cereal
	Pure Gluten Food Co., New York City.
1919-4b	Gluten Breakfast Food
1904-11	Gum Gluten Breakfast Food
1906-2e	Gum Gluten Breakfast Food
1911-2k	Gum Gluten Breakfast Food
1911-2k	Gum Gluten Granules
1916-4a	Gum Gluten Granules
1914-2q	Hoyt's Gum Gluten Breakfast Food
1914-2q	Hoyt's Gum Gluten Granules
1901-10b	Pure Gluten Breakfast Cereal
	Pure Gluten Food Co., Columbus, Ohio.
1919	Hoyt's Gluten Breakfast Food, 40% Protein
1919	Hoyt's Gluten Granules, over 40% Protein
	Waukesha Health Products Co., Waukesha, Wis.
1919	Hepco Grits
	MACARONI, NOODLES, ETC.
	Brusson Jeune, Villemur, France.
1910-2k	Pâtes aux Oeufs Macaroni
1910-2k	Pâtes aux Oeufs Nouillettes

OF DIABETIC FOODS—(*Continued*).

ƙeference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
}-2p	9.90	1.20	1.84	11.50	.....	0.90	62.70	12.50	1.30	359
}-2p	11.10	0.60	2.85	17.80	.....	0.50	54.10	14.50	1.40	358
}-10c	8.50	0.70	6.42	.....	36.60	....	53.20[2]		1.00	368
-2p	10.20	2.40	6.02	37.60	.....	1.10	31.00	15.80	1.90	355
-2q	7.56	2.53	6.82	.....	38.87	1.73	29.87	17.45	1.99	363
)	8.49	2.47	7.86	.....	44.80	1.09	21.99	12.47	8.69	396
)	7.65	5.39	6.42	40.13	.....	3.78	trace	24.88	18.17	424
-2p	6.20	1.80	2.06	.....	11.70	2.20	59.50	16.30	2.30	371
-2p	6.20	1.40	1.97	12.30	.....	1.10	65.40	11.90	1.70	374
-2k	6.10	2.30	2.22	13.90	.....	0.60	45.20	31.10	0.80	368
	4.52	4.61	5.86	36.63	.....	....	0.70	11.02[2]	42.52	576
	4.38	2.73	5.12	.....	29.18	1.04	25.51	17.78	19.38	464
-4b	9.17	1.32	7.16	.....	40.75	0.10	35.70	12.28	0.68	361
-11	9.50	0.90	8.70	.....	49.60	0.50	30.40	8.30	0.80	360
-2e	9.10	1.10	8.54	.....	48.70	0.30	31.00[1]	8.20	1.60	366
-2k	7.50	1.20	6.05	.....	34.40	0.40	37.90	17.30	1.30	370
-2k	7.50	1.50	7.28	.....	41.50	0.30	32.30	15.30	1.60	371
-4a	6.95	0.80	6.90	.....	39.33	0.08	40.50	11.42	0.92	363
-2q	6.48	0.60	7.26	.....	41.38	0.28	39.21	11.19	0.86	375
-2q	6.64	0.73	6.83	.....	38.93	0.45	41.93	10.63	0.69	372
-10b	9.30	0.70	6.99	.....	39.80	0.30	48.30		1.60	367
	9.23	0.93	8.07	.....	46.00	0.51	31.39	10.15	1.79	366
	9.75	0.97	7.68	.....	43.78	0.68	32.15	10.08	2.59	327
	8.88	5.51	6.44	40.25	.....	4.19	0.87	23.91	16.39	408
-2k	8.80	0.70	2.22	13.90	.....	trace	69.20	7.00	0.40	364
-2k	8.70	0.70	2.30	14.40	.....	trace	68.90	6.80	0.50	365

.ncludes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	MACARONI, NOODLES, ETC.—(*continued*).
	Brusson Jeune, Villemur, France—(*continued*).
1913-2p	Petites Pâtes au Gluten
1910-2k	Vermicelle au Gluten
	The Dieto Food Co., New York City.
1914-2q	Whole Wheat Brand Macaroni
	Jireh Diabetic Food Co., New York City.
1913-2p	Macaroni
	Eugene Loeb, New York City.
1913-2p	Home Made Noodles
	Loeb's Diabetic Food Bakery, New York City.
1916-2s	Gluten Noodles
1919	Gluten Noodles
	The Marvelli Co., Detroit, Mich.
1901-2b	Macaroni
1912-20	Spaghetti
	Pure Gluten Food Co., New York City.
1906-2f	Gum Gluten Macaroni
1911-2k	Gum Gluten Noodles
1914-2q	Hoyt's Gum Gluten Noodles
	PEANUT BUTTER.
	Atlantic Peanut Refinery, Philadelphia, Pa.
1899-2a	Peanut Butter
	J. W. Beardsley's Sons, New York City.
1913-2p	Acme Red Brand
1919	Acme Brand
	Beech-Nut Packing Co., Canajoharie, N. Y.
1913-2p	Beech-Nut
1919	Beech-Nut
	A. C. Blenner & Co., New Haven, Conn. (distributed by).
1913-2p	Peanut Butter
	D. W. Brooke, Newark, N. J.
1913-2p	Peanut Butter
	Dillon & Douglass, New Haven, Conn. (distributed by).
1913-2p	Perfection

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
913-2p	9.00	0.80	2.98	.....	17.00	0.20	61.20	10.80	1.00	365
910-2k	8.00	0.80	2.94	.....	16.80	trace	65.80	8.20	0.40	367
914-2q	9.81	0.90	2.22	13.88	.....	0.57	58.72	14.98	1.14	361
913-2p	8.80	1.10	2.70	16.90	.....	0.90	58.80	12.60	0.90	361
913-2p	9.80	1.00	6.69	41.80	.....	0.20	36.70	5.00	5.50	384
916-2s	9.25	0.69	7.23	.....	41.21	0.15	33.19	14.48	1.03	365
919	10.23	1.63	6.54	.....	37.28	0.15	36.84	10.28	3.59	370
901-2b	13.40	0.50	3.31	20.70	.....	....	64.80[2]		0.60	347
912-20	.....	....	2.48	15.50	.....	....	.....	.....	.....	...
906-2f	10.30	0.70	6.62	.....	37.70	0.30	46.20[1]	3.80	1.00	360
911-2k	8.30	1.10	5.86	.....	33.40	0.20	42.00	12.60	2.40	374
914-2q	8.21	0.65	6.48	.....	36.93	0.33	41.82	10.83	1.23	369
99-2a	2.10	4.00	4.59	28.70	.....	2.30	6.20	10.30	46.40	598
13-2p	2.20	4.40	4.51	28.20	.....	1.70	4.00	11.20	48.30	608
19	1.82	3.07	5.00	31.25	.....	1.77	5.29	8.53	48.27	615
13-2p	2.00	3.50	4.70	29.40	.....	1.90	4.50	12.10	46.60	593
19	1.99	3.32	4.86	30.38	.....	1.81	5.04	7.55	49.91	621
13-2p	2.90	4.00	4.75	29.70	.....	1.20	4.60	9.70	47.90	607
13-2p	1.80	3.80	4.72	29.50	.....	1.50	4.30	10.60	48.50	614
13-2p	1.80	4.40	4.66	29.10	.....	1.80	4.80	15.30	42.80	582

[1] Includes water-soluble carbohydrates. [2] Includes fiber.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	PEANUT BUTTER—(*continued*).
	H. J. Heinz Co., Pittsburgh, Pa.
1913-2p	Peanut Butter
	The Kellogg Food Co., Battle Creek, Mich.
1913-2p	Peanut Butter
1913-2p	Peanut Butter
	Francis H. Leggett & Co., New York City.
1913-2p	Premier
	MacLaren Imperial Cheese Co., Detroit, Mich.
1913-2p	Eagle
	Nut Products Co., New Haven, Conn.
1913-2p	Penolia
	Penolia Food Co., New Haven, Conn.
1899-2a	Penolia
	S. S. Pierce Co., Boston, Mass.
1913-2p	Acharis Brand
	ALMOND PASTE.
	Chapman, Chicago, Ill.
1902-1c	Almond Paste
	Henry Heide, New York City.
1902-1c	Almond Paste
	Spencer, New York City.
1902-1c	Almond Paste
	NUTS AND NUT PREPARATIONS.
	Dieto Food Co., New York City.
1914-2q	Pine Nuts
	Chas. Lawrence Co., Boston, Mass. (sold by).
1913-2p	California Paper Shell Almonds, edible portion
	Christian National Food Co., Kenilworth, N. J.
1916-2s	Christian's Protoid Nuts
	Jireh Diabetic Food Co., New York City.
1913-2p	Diabetic Pine Nuts (Pignolias)
	The Kellogg Food Co., Battle Creek, Mich.
1906-2e	Almond Butter (Sanitas)
1908-10c	Almond Butter (Sanitas)
1901-10b	Malted Nuts
1913-2p	Nut Bromose (Meltose and Nuts)
1906-2e	Nut Butter (Sanitas)

OF DIABETIC FOODS—(*Continued*).

	Water.	Ash.	Nitrogen.	Protein.		Fiber.	Nitrogen-free extract.		Fat.	Calories.
				N. x 6.25.	N. x 5.70.		Starch.	Other nitrogen-free extract, by difference.		
2p	3.00	3.90	4.62	28.90	.....	1.70	4.00	11.20	47.30	592
2p	3.10	3.00	4.50	28.10	.....	1.40	3.40	11.30	49.70	619
2p	3.60	3.30	4.90	30.60	.....	1.50	3.20	9.00	48.80	610
2p	2.10	4.00	4.75	29.70	.....	1.70	6.50	12.30	43.70	587
2p	1.50	3.80	5.14	32.10	.....	1.70	4.30	11.70	44.90	597
2p	2.40	3.90	4.46	27.90	.....	1.50	3.90	9.10	51.30	625
2a	2.00	6.00	4.78	29.90	.....	2.10	5.60	7.70	46.70	593
2p	1.70	3.70	4.59	28.70	.....	3.00	5.10	9.50	48.30	608
1c	23.70	1.40	2.10	13.10	.....	....	11.30	25.00[2]	25.50	427
1c	22.00	1.60	2.03	12.70	.....	....	small	43.70[2]	20.00	406
1c	27.00	1.70	2.16	13.50	.....	....	trace	31.60[2]	26.20	416
2q	2.23	4.55	6.35	39.69	.....	0.75	none	2.76	50.02	620
2p	3.50	3.50	2.94	18.40	.....	3.00	none	16.30	55.30	637
2s	4.23	4.27	6.02	37.63	.....	....	trace	5.65[2]	48.22	607
2p	2.00	4.60	6.35	39.70	.....	0.90	none	3.40	49.40	617
2e	0.90	2.90	3.62	22.60	.....	3.90	3.70[1]	4.50	61.50	677
10c	2.30	3.00	3.47	21.70	.....	....		11.50[2]	61.50	686
10b	2.60	2.20	3.79	23.70	.....	....		43.90[2]	27.60	519
2p	14.00	1.50	2.73	17.10	.....	1.20	3.20	36.20	26.80	467
2e	0.20	2.90	4.61	28.80	.....	3.70	9.10[1]	4.80	50.50	625

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	NUTS AND NUT PREPARATIONS—(*continued*).
	The Kellogg Food Co., Battle Creek, Mich.—(*continued*).
1906-2e	Nut Meal
1906-2e	Nuttolene
1913-2p	Pine Nuts
1906-2e	Protose
	Nashville Sanitarium-Food Co., Nashville, Tenn.
1913-2p	Malted Nut Food
1913-2p	Nut Butter
1913-2p	Nutcysa
1913-2p	Nutfoda
	CHOCOLATE AND CHOCOLATE PREPARATIONS.
	Brusson, Jeune, Villemur, France.
1913-2p	Chocolate with Added Gluten à la Vanille
	Callard, Stewart & Watt, London.
1913-2p	Casoid Chocolate Almonds
	Fromm & Co., Dresden.
1913-2p	Conglutin-Diabetiker-Schokolade
	Karl Goldscheider, Karlsbad.
1914-2q	Feinste Dessert-Schokolade für Diabetiker, "9.98% carbohydrate
1914-2q	Feinste Mocca-Schokolade für Diabetiker, "10.26% carbohydrate
1914-2q	Feinste Nuss-Schokolade für Diabetiker, "11.32% carbohydrates
1914-2q	Feinste Orange-Schokolade für Diabetiker, "9.98% carbohydrate
	Groetzsch, Frankfurt.
1910-9	Essschokolade (Orange)
1910-9	Kochschokolade
	Loeb's Diabetic Food Bakery, New York City.
1914-2q	Almond Chocolate Bars
1914-2q	Diabetic Chocolates
1919	Almond Chocolate Bars
1919	Diabetic Chocolate
	Plasmon Co., London.
1901-13a	Plasmon Chocolate
1903-2c	Plasmon Chocolate
	Rademann's Nährmittelfabrik, Frankfurt.
1910-5	Diabetiker-Chokolade
1913-2p	Diabetiker-Chokolade
	Troponwerke, Mülheim.
1898-7	Tropon-Chokolade
1899-8	Tropon-Chokolade

OF DIABETIC FOODS—(*Continued*).

Reference.	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, by difference.	Fat.	Calories.
06-2e	3.00	2.20	4.64	29.00	.....	2.00	8.90[1]	3.20	51.70	630
06-2e	55.20	2.20	2.03	12.70	.....	1.80	6.30		21.80	272
13-2p	2.60	4.50	6.08	38.00	.....	1.10	4.20		49.60	615
06-2e	62.20	1.50	3.62	22.60	.....	0.90	3.60		9.20	188
13-2p	3.40	1.70	3.95	24.70	.....	....	3.40	24.10[2]	42.70	593
13-2p	1.90	2.90	4.48	28.00	.....	1.60	3.80	9.20	52.60	637
13-2p	57.00	1.80	2.06	12.90	.....	1.00	trace	6.30	21.00	266
13-2p	62.30	1.60	3.33	20.80	.....	0.50	trace	6.80	8.00	182
13-2p	2.60	3.20	2.54	15.90	.....	2.20	9.20	17.20	49.70	617
13-2p	3.50	3.10	3.57	22.30	.....	3.20	trace	16.10	51.80	620
13-2p	4.00	5.40	2.82	17.60	.....	1.20	4.30	28.40	39.10	553
14-2q	2.17	1.80	1.82	11.38	.....	1.68	4.98	20.44	57.55	665
14-2q	2.20	2.25	1.63	10.19	.....	1.65	4.11	19.38	60.22	677
14-2q	3.37	2.65	2.34	14.63	.....	1.70	6.86	16.44	54.35	641
14-2q	2.38	2.20	1.83	11.44	.....	1.43	4.98	19.93	57.64	664
10-9	4.60	2.30	1.73	10.80	.....	4.40	12.00	5.20	60.70	658
10-9	10.90	6.70	4.05	25.30	.....	5.90	15.90	20.20	25.10	432
4-2q	2.88	3.77	2.60	16.25	.....	4.32	5.74	26.04	41.00	561
4-2q	1.98	3.85	2.38	14.88	.....	4.90	6.92	16.05	51.42	614
9	4.76	3.43	2.38	14.88	.....	2.81	5.34	15.55	53.23	622
9	4.72	3.45	2.35	14.69	.....	2.62	7.26	15.52	51.74	716
1-13a	.....	....	3.38	21.10	.....	....	.....	.....	.....	...
3-2c	3.50	2.50	3.23	20.20	.....	0.70	trace	48.00	25.10	499
0-5	.....	....	2.58	16.10	.....	....	9.60		.....	...
3-2p	2.50	3.20	2.80	17.50	.....	2.30	3.80	13.10	57.60	656
8-7	1.70	1.60	2.91	18.20	.....	2.70	49.90		25.90	506
9-8	1.80	....	2.94	18.40	.....	....	.....	.....	.....	...

[1] Includes water-soluble carbohydrates. [2] Includes *fiber*.

TABLE XI.—COMPILATION OF ANALYSES

Reference.	Manufacturer and Brand.
	COCOA.
	The Dieto Food Co., New York City.
1914-2q	Dieto Cocoa
	Jireh Diabetic Food Co., New York City.
1906-2e	Diabetic Cocoa
1906-2e	Diabetic Cocoa
	Gustav Müller, New York City (Agent).
1913-2p	Charrasse Gluto-Cacao
	Plasmon Co., London.
1903-2c	Plasmon Cocoa
	Rademann's Nährmittelfabrik, Frankfurt.
1913-2p	Diabetiker-Cacao
	MISCELLANEOUS PRODUCTS.
	Dieto Food Co., New York City.
1914-2q	Dieto Baking Powder
1914-2q	Dieto Barley Coffee
1917-2t	Longuets de Lausanne, **Manual Freres**
	Health Food Co., New York City.
1913-2p	Kaffeebrod
	Genevieve Jackson, Los Angeles, Calif.
1919	Dia-Biskit
	The Kellogg Food Co., Battle Creek, Mich.
1911-2l	Sanitas Meltose
	Mansfield Laboratories, Mansfield, Mass.
1914-2q	No Name (square)
1914-2q	No Name (hexagonal)
	Gustav Müller & Co., New York City.
1913-2p	Dr. Bouma Sugar-Free Fat-Milk
	S. S. Pierce Co., Boston, Mass. (prepared for)
1919	Svea Wafers
1900-14	Diabetes Milch, 5%, **Rose's**
1900-14	Diabetes Milch, 10%, **Rose's**
	D. Whiting & Sons, Boston, Mass.
1913-2p	Sugar-Free Milk (ave. 3 analyses)
1919	Sugar-Free Milk

OF DIABETIC FOODS—(*Concluded*).

	Water.	Ash.	Nitrogen.	Protein. N. x 6.25.	Protein. N. x 5.70.	Fiber.	Nitrogen-free extract. Starch.	Nitrogen-free extract. Other nitrogen-free extract, *by difference.*	Fat.	Calories.
-2q	4.29	5.40	3.77	23.56	.....	4.87	12.38	26.57	22.93	456
-2e	3.10	4.30	3.30	20.60	.....	3.60	32.60[1]	18.00	17.80	445
-2e	7.30	3.90	3.06	19.10	.....	3.40	29.00[1]	18.90	18.40	434
-2p	6.40	6.70	3.44	21.50	.....	3.10	16.30	23.80	22.20	446
-2c	8.90	6.60	8.45	52.80	.....	....	5.10	15.80[2]	10.80	392
-2p	5.20	5.90	2.82	17.60	.....	3.00	10.70	34.00	23.60	462
-2q	.....	....	.....	.....	.....	....	12.94	.....	.....	...
-2q	3.42	3.08	2.11	13.19	.....	9.14	17.72	46.15	7.30	374
-2t	10.78	3.04	2.27	14.19	.....	0.44	49.16	16.86	5.53	370
-2p	4.50	2.20	2.06	12.90	.....	6.40	10.10	62.40	1.50	355
	6.08	6.13	2.82	17.63	.....	11.99	6.13[4]	47.21	4.83	328
-2l	26.80	0.50	0.10	0.60	.....	....	.....	72.10[2]	.....	291
-2q	9.34	5.53	4.72	29.50	.....	0.43	34.26	13.53	7.41	376
-2q	8.65	4.84	4.06	25.38	.....	0.47	31.16	14.33	15.17	420
-2p	91.80	0.50	0.38	2.40	.....	....	.....	.....	5.30	57
	10.58	2.85	1.04	6.50	.....	0.13	53.72	25.53	0.69	349
-14	92.50	0.20	0.18	1.10	.....	....	.....	1.20	5.00	54
-14	86.30	0.20	0.37	2.30	.....	....	.....	1.20	10.00	104
-2p	86.40	0.70	0.91	5.70[5]		....	.....	trace	7.20	88
	83.30	0.76	1.01	6.43[5]		....	.....	0.22[6]	9.34	111

[1] ncludes water-soluble carbohydrates.
[2] ncludes fiber.
[5] Nitrogen x 6.38.
[6] Reducing sugar calculated as lactose.

GENERAL SUMMARY.

Analyses from Connecticut Report, 1913		387
Analyses from Connecticut Reports since 1913		107
New analyses made in this laboratory in 1919:		
Commercial diabetic products	85	
Commercial and experimental preparations	22	107
Recent analyses compiled from other sources		51
Total		652

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 221 MARCH, 1920

BEING THE

Report on Commercial Feeding Stuffs

1919

By E. M. BAILEY

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he Bulletins of this Station are mailed free to citizens of Connecti-
t who apply for them, and to others as far as the editions permit.

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March, 1920.

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Commercial Feeding Stuffs

By E. M. Bailey.*

PROVISIONS OF THE STATUTES RELATING TO FEEDING STUFFS.

Under the Connecticut statutes the term "concentrated commercial feeding stuffs" covers practically all feeds excepting hay and straw, whole seeds, unmixed meal made directly from any of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Section 4775 requires that every lot or parcel of concentrated commercial feeding stuff shall bear a statement giving the name and address of the manufacturer or importer, the number of net pounds in the package, the name of the article, and the percentages of protein and fat contained in it. The law forbids the use of any metal in affixing tags.

No registration of feeds or payment of analysis or license fees is required.

The penalty for violation of the statute is not more than $100 fine for the first offense and not more than $200 for each subsequent offense.

The law authorizes this Station to take samples from any manufacturer or dealer, in a prescribed manner, and requires the Station to analyze annually at least one sample of each brand which it has collected, and to publish these analyses "together with such additional information in relation to the character, composition and use thereof as may be of importance."

THE STATUS OF COTTONSEED MEAL UNDER THE NEW FERTILIZER LAW.

By act of the General Assembly of 1919 cottonseed meal is classed as a commercial fertilizer within the meaning of the law.

* With the assistance of Messrs. C. E. Shepard and H. D. Edmond. The inspection and collection of samples were carried out by Mr. V. L. Churchill.

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It is required that every brand shall be registered at this Station before it is offered for sale in the state, and an analysis fee of ten dollars paid thereon. On July first and January first thereafter a tonnage fee of six cents per ton shall be paid. It is provided that cottonseed meal sold and used as feeding stuff shall be exempt from the tonnage fee.

As regards the adjustment of the tonnage fee, the law provides for a sworn statement from dealers as to their sales. This Station will provide forms for this purpose, the same to be duly filled in, certified and returned to the Station semi-annually. Said statement shall show the total tonnage sold and the proportion thereof sold for use as a fertilizer; and such statement will be used as a basis to determine the deduction in tonnage to be made for goods sold for feeding purposes.

CLASSIFICATION OF SAMPLES ANALYZED DURING THE YEAR.

In the official inspection two hundred and four samples were collected, which may be classified as follows:

Cottonseed Meal	15	Maize Products	19
Cottonseed Feed	2	Brewers' and Distillers' Grains	3
Linseed Meal	7	Dried Beet Pulp	6
Wheat Bran	15	Cocoanut Meal	2
Wheat Mixed Feed	15	Peanut Meal	2
Wheat Middlings	12	Proprietary Stock Feeds	78
Rye Products	3	Poultry Feeds	14
Barley Products	1		
		Total	204

Sixty-two samples of miscellaneous feeding stuffs have been examined for the Dairy Commissioner and for individuals.

Four hundred and sixty-seven partial or complete analyses have been made of fodder and other materials in connection with field experiments. Of this number three hundred and ninety-one were received from Storrs and the remainder were from the Station Farm at Mt. Carmel.

Partial analyses of thirty-one samples of shelled corn were made for the Department of Plant Breeding.

The total for the year is seven hundred and sixty-four.

This report is concerned only with the results of the official inspection and samples submitted by the Dairy Commissioner and by individuals.

DETERMINING FACTORS IN COMPOUNDING RATIONS.

Gross and Digestible Nutrients.

The significance of the conventional analysis of a feeding stuff and the rôle of each of the nutrient groups contained therein have been discussed in previous bulletins.[1] Such proximate analyses show the gross amounts of nutrient materials in various concentrates or roughages but do not furnish any information as to the nature and quality of the several types of nutrients found. The gross supply of nutrient material eaten is not entirely utilized in the animal body; some is lost in the excretions. The amount not excreted is considered to be utilized or digested; thus if 100 parts of protein are fed in a given ration, e. g., cottonseed meal, and 16 parts are recovered in the excreta, then 84 parts are assumed to have been digested and 84 is the coefficient of digestibility for the protein of cottonseed meal. These figures are obtained by actual feeding experiments. Such trials also show that protein, fat and carbohydrate have different degrees of digestibility, and that the same type of nutrient from different sources may vary in this respect. Thus the protein of dried beet pulp is only 52 per cent. digestible. Henry and Morrison[2] have prepared a useful table which gives data of this kind upon a very wide range of fodder materials.

Energy Values.

To illustrate the various transformations of food in digestion, the animal body is often compared with an engine and the food with fuel. Feeding experiments all prove the fitness of this comparison. As the engine transforms the energy of its fuel supply into other forms, such as heat and mechanical work, so the animal body transforms the energy of its food; and in both cases the general law of conservation of energy holds true since the total amount of energy in the fuel or food is eventually accounted for in some form.

The gross energy value of any food is equal to the heat evolved upon burning that food completely. This is determined by means of an apparatus called a calorimeter, in which a definite amount of food material is burned with pure oxygen under pressure, the

[1] Conn. Agr. Exp. Sta., Bull. 206, Feb., 1918; Bull. 212, March, 1919.

[2] Feeds and Feeding, p. 647, et seq.

ırbed by a weighed amount of water and
meter. If the amount of food material
d liberates heat enough to raise the
ams of water 1 degree Centigrade (or
rees Fahrenheit), the energy equivalent
erial is one *Calorie.* Another unit of
'hich has a value 1000 times that of the
amount of heat required to raise the
nds of water 4 degrees F. By burning
ırious types of nutrient materials their
ıhed.

' of energy in food material cannot be
e animal body it is evident that the fuel
judged by that proportion of the gross
can convert to its use. Deduction must
e energy lost to the body in the solid,
:ta. The remainder is the *available* or
represents that part of the gross energy
nsform; or its value to the animal for
s. But further energy is required in
reparing it for absorption and assimila-
rther deduction the *net energy value* of

heat liberated being absorbed by a weighed amount of water and measured with a thermometer. If the amount of food material when completely burned liberates heat enough to raise the temperature of 1000 grams of water 1 degree Centigrade (or 1 pound of water 4 degrees Fahrenheit), the energy equivalent of that amount of material is one *Calorie*. Another unit of measure is the Therm, which has a value 1000 times that of the Calorie, i. e., it is the amount of heat required to raise the temperature of 1000 pounds of water 4 degrees F. By burning unit quantities of the various types of nutrient materials their energy values are established.

Since the gross supply of energy in food material cannot be completely utilized by the animal body it is evident that the fuel value of a given food is judged by that proportion of the gross supply which the animal can convert to its use. Deduction must be made therefor for the energy lost to the body in the solid, liquid and gaseous excreta. The remainder is the *available* or *metabolizable* energy and represents that part of the gross energy which the animal can transform; or its value to the animal for heat production purposes. But further energy is required in digesting the food and preparing it for absorption and assimilation. By making this further deduction the *net energy value* of the food is obtained, and it represents that part of the original gross supply finally counted on to maintain the activities of heart. lungs and other internal organs and, if the supply is in excess of these requirements, to contribute to the gain of flesh or the production of milk or the performance of mechanical work.

Differences between various feeding stuffs with respect to metabolizable energy are chiefly due to the varying energy losses in the excreta. Metabolizable energy per unit of digestible organic matter therefore shows considerable uniformity and may be estimated on that basis. For this purpose Armsby[1] gives the following factors which may be used for cattle and probably for other ruminants.

Roughage	1.588 Therms per lb.
Grains and similar feeds:	
less than 5% digestible fat	1.769 Therms per lb.
more than 5% digestible fat	1.814 Therms per lb.
Oil meals, etc.	1.996–2.177 Therms per lb.

[1] Penn. Agr. Exp. Sta., Bull. 142, 1916.

To obtain net energy values, however, a further deduction for the energy expended in the consumption of feed is required. This energy expenditure has been determined by Armsby and Fries[1] for a number of roughages and concentrates and they have prepared the following table which includes their own results and others obtained by Kellner and Köhler.

TABLE I. AVERAGE ENERGY EXPENDITURE BY CATTLE PER HUNDRED POUNDS OF DRY MATTER EATEN.

	Energy Expenditure, Therms.
Roughages.	
Timothy hay	35.47
Red clover hay	44.13
Red clover hay	42.27
Mixed hay	44.45
Alfalfa hay	53.03
"Grass hay"	47.40
Meadow hay	56.88
Rowen	43.46
Corn stover	48.31
Wheat straw	51.62
Barley straw	39.78
Oat straw	46.00
Straw pulp	52.62
Concentrates.	
Corn meal	58.33
Hominy chop	61.92
Wheat bran	53.39
Grain mixture No. 1	60.19
Grain mixture No. 2	51.76
Cottonseed meal	44.36
Linseed meal	54.79
Palmnut meal	45.68
Peanut meal	52.57
Beet molasses	44.82
Starch	56.61
Peanut oil	78.34
Wheat gluten	95.08

—e application of these data in the case of cottonseed me for example, having 91.8 per cent. dry matter and 66.3 per ce digestible nutrients is as follows:

[1] Penn. Agr. Exp Stat, Bull 142, 1916.

One hundred pounds of cottonseed meal contain:

Dry matter	91.8 lbs.
Digestible	
Protein	30.2 lbs.
Fat	6.1 lbs.
Carbohydrates (includes digestible fiber)	30.0 lbs.
Total	66.3 lbs.

From the table on page 248 it appears that the metabolizable energy in one hundred pounds of cottonseed meal may be taken approximately as 2.1 Therms; and from Table I that the energy expenditure in consumption of one hundred pounds dry matter is 44.36 Therms. Thus

Metabolizable energy =	2.1 x 66.3 =	139.2 Therms
Expenditure of consumption =	.4426 x 91.8 =	40.7 Therms
Net energy value	=	98.5 Therms

On the basis of Henry and Morrison's compilation of American analyses of feeding stuffs and digestible nutrients therein, Armsby and Putney[1] have computed net energy values for a great variety of feeds; and the net energy values in the following table are taken from this source (Table II).

Energy values of feeding stuffs may be expressed in other ways. Kellner[2] has adopted the *starch value* as a standard of measurement. He found by experiment that one pound of digestible starch fed to an ox in excess of his maintenance requirements produced about one quarter (0.248) of a pound of body fat. One hundred pounds of a feed which produced twenty pounds of fat would have a starch value of about 80. Fraps[3] uses *productive value* as a basis of comparison, this being the amount of fat a given feed will produce upon a fattening animal when fed in addition to a basal ration already adequate for the bodily needs of the animal. He expresses productive value in terms of fat and takes into account the variations in the productive values of the several groups of digestible nutrients. Productive value is calculated by means of production coefficients established for each class of nutrients.

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[1] Penn. Agr. Exp. Stat., Bull. 142, 1916.

[2] Henry and Morrison, 15th ed., pp. 118-119.

[3] Texas Agr. Exp. Sta., Bull. 185.

Table II. Coefficients of Digestibility and Net Energy Values of Feeding Stuffs.[1]

Feed	Average dry matter, lbs. per hundred.	Coefficient of digestibility.				Net energy value, Therms per hundred lbs.
		Protein.	Fiber.	Carbohydrates.	Fat.	
Cottonseed Meal	92 2	84	37	75	95	90.0
Cottonseed Feed	....	58	45	61	90	....
Linseed Meal (old process)	90.0	89	57	78	89	88.9
Linseed Meal (new process)	90.4	86	73	87	95	85.1
Wheat Bran	89.9	76	43	74	62	53.0
Wheat Feed	....	77	36	76	87	....
Wheat Middlings	89.6	77	30	78	88	59.1
Red Dog Flour	....	88	36	88	86	....
Rye Flour	....	80	..	88	90	....
Barley, ground	90.7	88	70	93	86	89.9
Barley Bran	....	85	20	86	87	....
Corn Gluten Meal	90.9	85	55	90	93	84.2
Corn Gluten Feed	91.3	85	76	88	85	80.7
Hominy Feed	89.9	66	76	90	91	81.3
Brewers' Grains	92.5	81	49	57	89	53.4
Malt Sprouts	92.4	77	87	80	85	72.7
Distiller's Grains, Corn	93.4	73	95	81	95	85.1
Distiller's Grains, Rye	92.8	59	..	67	84	56.0
Beet Pulp, dried	91.8	52	83	83	..	75.9
Peanut Cake, without shells	89.3	90	9	84	90	93.6
Soybean Meal, fat extracted	88.2	92	99	100	68	99 7
Cocoanut Cake	90.4	90	23	87	100	83.5

[1] Henry and Morrison; Armsby and Putney.

Other Important Considerations.[1]

Feeding problems cannot, however, be entirely solved by knowledge of energy values, digestibility coefficients or nutritive ratios, useful as these may be for the purposes they are intended to serve. Many of the difficulties encountered in feeding have arisen from ignorance of the nature and quality of the ingredients of the feed. The striking differences in the feeding values of different proteins as shown by investigations at this Station and elsewhere illustrate this point and emphasize the fact that a knowledge of the chemical constitution of nutrient materials is quite as important as a knowledge of energy values.

[1] We quote largely from an unpublished paper by Dr. T. B. Osborne read at a conference of County Agents and others at this Station.

In feeding animals the quantity, kind and proportion of nutrients should be kept in mind.

As to quantity, energy values indicate how much should be fed per unit of live weight of the animal or unit of its production. Whether the animal will eat that amount of food or not depends upon the food or upon the animal. If the animal is healthy but does not eat as it should and does not grow, the food is inadequate in some way; if the food is corrected so that it produces growth, the animal will then eat as much as it should.

As to kinds of food, protein is of course necessary for its tissue-building qualities and fats and carbohydrates are necessary sources of energy. Mineral salts are also essential. There are conspicuous differences among proteins as regards nutritive values. For example, if zein is the sole source of protein in an animal's diet it dies within a short time. If zein is supplemented by tryptophane, or a protein containing it, the animal continues to live but does not grow. Finally if lysine is added to the ration the animal not only maintains itself but grows normally. Our present knowledge of carbohydrates and fats does not indicate such radical differences in nutritive values. Their functions in metabolism are different from that of protein. Probably the carbohydrates are chiefly valuable insofar as they may be converted into dextrose in digestion. Mineral nutrients are more important than has been generally supposed and it is important that the ration contain a sufficient amount of these materials. A corn and skimmed milk ration can be improved by adding calcium and chlorine to compensate the deficiency of these elements in corn.

Nutritive ratios indicate the proportion in which the different types of nutrients should be fed for particular purposes. Thus narrow ratios are fed for growth and production while wide ratios suffice for maintenance. But it has been shown that a young animal obtaining all its protein from gluten feed grows very poorly even though the nutritive ratio of the ration is narrow; and that by supplementing a part of the protein supply by the protein of milk, marked improvement in the rate of growth results even though the nutritive ratio remains the same. Nutritive ratios then can be most efficiently applied only with a knowledge of the nature and quality of the nitrogenous part of the ration.

An important feature of animal feeding is the proper and rational use of roughage. This problem is complicated by the fact that very little is known about the chemical constitution of the nitrogenous constituents of green leaves. These constituents are conventionally classed as proteins but this practice may be very far from the truth. Osborne and Wakeman have lately shown that about 50 per cent. of the nitrogen of spinach leaves is in protein form, 20 per cent. is non-protein and the nature of the remaining 30 per cent. has yet to be determined. This represents practically the sum of our present knowledge of the proteins in green foods.

Some of the practical conclusions to be drawn from these newer ideas regarding nutrition may be briefly summarized. It is a waste of good protein to mix it with feeds which are already adequate for normal growth or production. The more economical use of such protein is in supplementing those proteins which are deficient in kind or quantity of requisite amino acids. Again, although good results may sometimes be obtained by feeding enough poor protein, it is cheaper to feed less amounts of good protein because the market price will generally be about the same for each kind. Food intake is determined by the energy requirements of the animal; a maximum production cannot be expected without a maximum consumption of food. The animal is a machine which must be made to produce at a maximum capacity if it is to be run at a profit. If a healthy animal does not eat as much as it should there is generally something wrong with the food; if its consumption is normal but its production is low, something is wrong with the animal. The maximum capacity for growth or production is an inherited quality; it cannot be increased by feeding but it may be decreased by feeding improperly.

Recent work done at this Station and elsewhere proves that to the four or five nutrients hitherto considered as making a perfect food, must be added others, known as food accessories or vitamines. These are needed in only small amounts but are absolutely essential to maintenance and growth. While their nature and functions are not fully understood the work already done shows the special value of alfalfa, clover and green feed for growing stock, due to these valuable constituents.

DEFINITIONS OF FEEDING STUFFS.

Definition of feeding stuffs adopted by the Association of Feed Control Officials of the United States and revised to January, 1919, are as follows:

General Definitions.

Meal is the clean, sound, ground product of the entire grain, cereal or seed which it purports to represent.

Chop is a ground or chopped feed composed of one or more different cereals or by-products thereof. If it bears a name descriptive of the kind of cereals, it must be made exclusively of the entire grains of those cereals.

Screenings are the smaller, imperfect grains, weed seeds and other foreign material having feeding value, separated in cleaning the grain.

Alfalfa meal is the entire alfalfa hay ground, and does not contain an admixture of ground alfalfa straw or other foreign materials.

Animal Products.

Blood meal is ground dried blood.

Cracklings are the residue after partially extracting the fats and oils from the animal tissue. If they bear a name descriptive of their kind, composition or origin, they must correspond thereto.

Digester Tankage is the residue from animal tissue, exclusive of hoof and horn, specially prepared for feeding purposes by tanking under live steam, drying under high heat, and suitable grinding. If it contains more than 10 per cent. of phosphoric acid ($P_2 O_5$) it must be designated *Digester Meat and Bone Tankage.*

Meat Scrap and *Meat Meal* are the ground residues from animal tissues exclusive of hoof and horn. If they contain more than 10 per cent. of phosphoric acid ($P_2 O_5$) they must be designated *Meat and Bone Scrap and Meat and Bone Meal.* If they bear a name descriptive of their kind, composition or origin, they must correspond thereto.

Brewers' and Distillers' Products.

Brewers' Dried Grains are the properly dried residue from cereals obtained in the manufacture of beer.

Distillers' Dried Grains are the dried residue from cereals obtained in the manufacture of alcohol and distilled liquors. The product shall bear the designation indicating the cereal predominating.

Malt Sprouts are the sprouts of the barley grain. If the sprouts are derived from any other malted cereal, the source must be designated.

Buckwheat Products.

Buckwheat Shorts or *Buckwheat Middlings* are that portion of the buckwheat grain immediately inside of the hull after separation from the flour.

Corn Products.

Corn Bran is the outer coating of the corn kernel.

Corn Feed Meal is the by-product obtained in the manufacture of cracked corn, with or without aspiration products added to the siftings, and is also the by-product obtained in the manufacture of table meal from the whole grain by the non-degerminating process.

Corn Germ Meal is a product in the manufacture of starch, glucose and other corn products, and is the germ layer from which a part of the corn oil has been extracted.

Grits are the hard, flinty portions of Indian corn, without hulls and germs.

Corn Gluten Meal is that part of commercial shelled corn that remains after the separation of the larger part of the starch, the germ and the bran, by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

Corn Gluten Feed is that portion of commercial shelled corn that remains after the separation of the larger part of the starch and the germ by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

Hominy Feed, Hominy Meal or *Hominy Chop* is the kiln-dried mixture of the mill run bran coating, the mill run germ, with or without a partial extraction of the oil and a part of the starchy portion of the white corn kernel obtained in the manufacture of hominy, hominy grits and corn meal by the degerminating process.

Yellow Hominy Feed, Yellow Hominy Meal or *Yellow Hominy Chop* is a kiln-dried mixture of the mill run bran coating, the mill run germ, with or without a partial extraction of the oil and a part of the starchy portion of the yellow corn kernel obtained in the manufacture of yellow hominy grits and yellow corn meal by the degerminating process.

Oil Cake.

Oil Cake is the residual cake obtained after extraction of part of the oil by crushing, cooking and hydraulic pressure from seeds screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "oil cake" shall be understood to designate the product obtained from partially extracted, screened and cleaned flaxseed. When used to cover any other product, the name of the seed from which it is obtained shall be prefixed to "oil cake."

Ground Oil Cake is the product obtained by grinding oil cake. When used alone, the term "ground oil cake" shall be understood to designate the product obtained from partially extracted, screened and cleaned flaxseed. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to "ground oil cake."

Cottonseed Products.

Cottonseed Meal is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the

manufacture of oil; provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent. of protein.

Choice Cottonseed Meal must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint, and must contain at least 41 per cent. of protein.

Prime Cottonseed Meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and must contain at least 38.6 per cent. of protein.

Good Cottonseed Meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, and must contain at least 36 per cent. of protein.

Cottonseed Feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent. of protein.

Cold Pressed Cottonseed is the product resulting from subjecting the whole undecorticated cottonseed to the cold pressure process for the extraction of oil, and includes the entire cottonseed less the oil extracted.

Ground Cold Pressed Cottonseed is the ground product resulting from subjecting the whole undecorticated cottonseed to the cold pressure process for the extraction of oil, and includes the entire ground cottonseed less the oil extracted.

Linseed and Flax Products.

Linseed Meal is the ground product obtained after extraction of part of the oil from ground flaxseed screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes, provided that the final product shall not contain over six per cent. of weed seeds and other foreign materials and provided further that no portion of the stated six per cent. of weed seeds and other foreign materials shall be deliberately added.

Oil Meal is the ground product obtained after the extraction of part of the oil by crushing, cooking and hydraulic pressure, or by crushing, heating and the use of solvents from seeds which have been screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "Oil Meal" shall be understood to designate linseed meal as defined. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to the words "oil meal."

Old Process Oil Meal is the ground product obtained after extraction of part of the oil by crushing, cooking and hydraulic pressure from seeds screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "Old Process Oil Meal" shall be understood to designate linseed meal as defined, made by the old process. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to "old process oil meal."

New Process Oil Meal is the ground product obtained after extraction of part of the oil by crushing, heating and the use of solvents from seeds

screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes. When used alone the term "New Process Oil Meal" shall be understood to designate linseed meal as defined, made by the new process. When used to cover any other product the name of the seed from which it is obtained shall be prefixed to "new process oil meal."

Flax Plant By-Product is that portion of the flax plant remaining after the separation of the seed, the bast fiber and a portion of the shives, and consists of flax shives, flax pods, broken and immature flax seeds, and the cortical tissue of the stem.

Ground Flaxseed or *Flaxseed Meal* is the product obtained by grinding flaxseed which has been screened and cleaned of weed seeds and other foreign materials by the most improved commercial processes, provided that the final product shall not contain over four per cent. of weed seeds and other foreign materials, and provided further that no portion of the stated four per cent. of weed seeds and other foreign materials shall be deliberately added.

Unscreened Flaxseed Oil Feed is the ground product obtained after extraction of part of the oil from unscreened flaxseed by crushing, cooking and hydraulic pressure, or by crushing, heating and the use of solvents. When sold without grinding the unground product shall be designated as "unscreened flaxseed oil feed cake."

Ingredients of Unscreened Flaxseed Oil Feed—Ground cake from partially extracted flaxseed and foreign seeds (wheat, wild buckwheat, pigeon grass, wild mustard, etc.).

Screenings Oil Feed is the ground product obtained after extraction of part of the oil by crushing, cooking and hydraulic pressure, or by crushing, heating and the use of solvents from the smaller imperfect grains, weed seeds and other foreign materials having feeding value separated in cleaning the grain. The name of the grain from which the screenings are separated shall be prefixed to "screenings oil feed."

Oat Products.

Oat Groats are the kernels of the oat berry.

Oat Hulls are the outer chaffy coverings of the oat grain.

Oat Middlings are the floury portions of the oat groat obtained in the milling of rolled oats.

Oat Shorts are the covering of the oat grain lying immediately inside the hull, being a fuzzy material carrying with it considerable portions of the fine floury part of the groat obtained in the milling of rolled oats.

Clipped Oat By-Product is the resultant by-product obtained in the manufacture of clipped oats. It may contain light chaffy material broken from the ends of the hulls, empty hulls, light, immature oats and dust. It must not contain an excessive amount of oat hulls.

Peanut Products.

Peanut Oil Cake is the residue after the extraction of part of the oil by pressure or solvents from peanut kernels.

Peanut Oil Meal is the ground residue after the extraction of part (the oil from peanut kernels.

Unhulled Peanut Oil Feed is the ground residue obtained after extra tion of part of the oil from whole peanuts, and the ingredients shall l designated as *Peanut Meal and Hulls.*

RICE PRODUCTS.

Rice Bran is the cuticle beneath the hull.

Rice Hulls are the outer chaffy coverings of the rice grain.

Rice Polish is the finely powdered material obtained in polishing tl kernel.

WHEAT PRODUCTS.

Wheat Bran is the coarse outer coatings of the wheat berry obtained i the usual commercial milling process from wheat that has been cleane and scoured.

Shorts or *Standard Middlings* are the fine particles of the outer an inner bran separated from bran and white middlings.

Wheat White Middlings or *White Middlings* are that part of the off: of wheat intermediate between shorts or standard middlings and red do:

Shipstuff or *Wheat Mixed Feed* is a mixture of the products other tha the flour obtained from the milling of the wheat berry.

Red Dog is a low grade wheat flour containing the finer particles of bra

Wheat Bran with Mill Run Screenings is pure wheat bran plus tl screenings which were separated from the wheat used in preparing sai bran.

Wheat Bran with Screenings not Exceeding Mill Run is either whe bran with the whole mill run of screenings or wheat bran with a portio of the mill run of screenings, provided that such portion is not an inferic portion thereof.

MISCELLANEOUS PRODUCTS.

Yeast or *Vinegar Dried Grains* are the properly dried residue from th mixture of cereals, malt and malt sprouts (sometimes cottonseed meal obtained in the manufacture of yeast or vinegar, and consists of corn c corn and rye from which most of the starch has been extracted, togethe with malt added during the manufacturing process to change the starc to sugars, and malt sprouts (sometimes cottonseed meal) added durin the manufacturing process to aid in filtering the residue from the wo and serve as a source of food supply for the yeast.

Palm Kernel Oil Meal is the ground residue from the extraction c part of the oil by pressure or solvents from the kernel of the fruit c *Elaeis guineensis* or *Elaeis malanococca.*

Ivory Nut Meal is ground ivory nuts.

TENTATIVE DEFINITIONS.

Barley Feed is the entire by-product resulting from the manufacture o pearl barley made from clean barley.

Barley Mixed Feed is the entire offal from the milling of barley flour from clean barley and is composed of barley hulls and barley middlings.

Dried Beet Pulp is the material obtained by drying the residue from sugar beets which have been extracted in the process of manufacturing sugar and shall not contain excessive amounts of crowns, tails or sand.

Cocoanut Oil Meal is the ground residue from the extraction of part of the oil from the meat of the cocoanut.

Wheat Bran consists of the coarse outer coatings of the kernel obtained in the usual commercial process of milling from wheat that has been cleaned and scoured.

Shorts or *Standard Middlings* consists mostly of the fine particles of bran and germ and contains very little of fibrous offal obtained from the "tail of the mill."

Gray (or total) *Shorts* consists of the fine particles of the outer bran, the inner or "Bee-wing" bran, the germ and the offal or fibrous material, obtained in the last reductions in milling.

White Shorts or *White Middlings* consists of a smaller portion of the fine bran particles and the germ and a much greater portion of the fibrous offal from the "tail of the mill."

Red Dog consists of a mixture of low-grade flour, fine particles of bran and the fibrous offal from the "tail of the mill."

Wheat Mixed Feed consists of pure wheat bran and the gray or total shorts or middlings combined in the proportions obtained in the usual process of commercial milling.

Wheat Bran and Standard Middlings consists of the two commodities as defined above mixed in the proportions obtained in the usual process of commercial milling.

(NOTE—If to any of the foregoing brands of feed there should be added screenings, or scourings, as hereinafter defined, either ground or unground, bolted or unbolted, such brand shall be so registered, labeled and sold as clearly to indicate this fact. The word "Screenings" or "Scourings" as the case may be, shall appear as a part of the name or brand and shall be printed in the same size and face of type as the remainder of the brand name.)

Screenings consists of the smaller imperfect grains, weed seeds and other foreign materials having feeding value separated in cleaning the grain.

Scourings consists of such portions of the cuticle, brush, white caps, dust smut, and other materials as are separated from the grain in the usual commercial process of scouring.

INSPECTION OF 1919.

REMARKS ON ANALYSES.

(*Analyses on pages 370-393.*)

Cottonseed Meal. Of the fifteen samples examined only two exceeded 40 per cent. protein. The average protein content is 37.10 per cent. as compared with 36.01 per cent. the preceding

year. Collectively the samples have exceeded their guaranties by about 0.6 per cent. protein and 1.4 per cent. fat. The average price of $82.67 is an increase of about 25 per cent. over the price a year ago. Deficient samples are noted in Table III.

Cottonseed Feed. Only two samples were examined, one of which was deficient in protein and contained excess fiber. These two brands sold at cottonseed meal prices.

Linseed Meal. The quality this year, as judged by the protein content, is lower than the average last year by about 3 per cent. The price has ranged from $82.00 to $93.00 per ton. As compared with cottonseed meal it has averaged nearly $3.00 per ton higher in price and carried 4.3 per cent. less protein.

Wheat Products. The quality of these products has been generally satisfactory and guaranties have been met in nearly every instance. Middlings have sharply advanced in price, the average, $68.62, being about $17.00 per ton more than the average in 1918. The price of wheat feed has averaged somewhat less than last year.

Rye, Barley and Maize Products have maintained average quality but prices have considerably advanced in most cases.

Miscellaneous Feeds. Peanut oil meal has sold for $75.00 to $81.00 per ton as compared with $58.00 last year. No samples of velvet bean feed have been found in this inspection. Apparently stock becomes accustomed to this feed rather slowly even in mixture although no trouble of this sort is experienced in the South. Copra cake meal is used to an increasing extent as an ingredient of mixed feeds. Its proteins are of a desirable kind and both fat soluble and water soluble vitamines are present.

Proprietary Mixed Feeds. When compounded with materials of good quality these feeds possess undoubted merit. The variety of sources from which they derive their nutrients makes possible a supplementing of nutritive qualities which modern ideas of efficient feeding endorse as a rational practice. The criticism of them is that on account of their variety, they furnish an outlet for low-grade materials of little worth. Some of these show plainly on the tags the ingredients of which they are composed. While the law in this State does not require such information it is a valuable guide to the feeder, and is given in case of the following brands:

grane Milk Feed. Cottonseed meal, linseed oil meal, corn gluten feed, ground corn, wheat middlings (with screenings), ground barley, molasses, one-half of one per cent. salt, oat hulls, shorts, clippings not over 600 pounds per ton.

Bufceco Chop Feed. Ground corn, oats and barley, hominy feed, oat shorts and oat hulls.

Bufceco Dairy Feed. Ground corn, wheat bran and middlings, hominy feed, corn gluten feed, oat shorts, oat middlings, oat hulls, one-half of one per cent. salt.

Bufceco Horse Feed. Ground corn, oats and barley, hominy feed, oat shorts, oat hulls, linseed meal, corn gluten feed, wheat middlings containing mill run ground screenings, one-half of one per cent. salt.

Crosby's 1918 Dairy Ration. Distillery dried grains, cottonseed meal, peanut meal, brewers' dried grains, hominy feed and oat feed (oat hulls, oat shorts and oat middlings).

Crosby's Stock Food. Ground barley, ground hominy feed, ground oats, oat feed (oat hulls, oat shorts, oat middlings).

Emerald Horse Feed. Cracked corn, oats, barley, alfalfa meal and molasses.

H. & S. Horse, Mule and Dairy Feed. Crushed flaxseed meal, old process oil meal, alfalfa meal, dried brewers' and distillers' grains, pure cane syrup, one-half of one per cent. salt.

Mystic Feed. Ground oats and barley, wheat middlings, corn meal, white hominy feed, oat middlings, oat hulls, old process oil meal, not over one per cent. salt.

Pennant Brand Stock Feed. Fine white hominy and oat by-products (oat middlings, hulls and shorts).

Purina Cow Chow Feed. Old process linseed oil meal, gluten feed from corn, hominy feed, cottonseed meal, ground alfalfa, molasses and one per cent. salt.

Purina Pig Chow. Hominy feed, cane molasses, ground barley, gluten feed from corn, cracked corn, digester tankage, old process linseed oil meal, alfalfa, charcoal, one per cent. salt.

Big Q Dairy Ration. Cottonseed meal, corn distillers' grains, corn gluten feed, old process linseed oil meal, wheat middlings, wheat bran (with screenings not exceeding mill run), oat meal mill by-products (oat middlings, hulls and shorts), hominy feed, yellow hominy feed, one per cent. salt.

Read the Tag Dairy Feed. Cottonseed meal, corn gluten feed, linseed oil meal, corn meal, hominy feed, ground barley, wheat middlings (with mill run screenings), molasses, three-fourths of one per cent. salt, oat hulls and oat shorts not over 225 pounds per ton.

Biles Ready Dairy Ration. Corn distillers' grains, choice cottonseed meal, old process linseed meal, white wheat middlings, winter wheat bran, hominy meal, cocoanut oil meal, corn gluten feed, brewers' dried grains, barley malt sprouts, one-half per cent. fine table salt.

Yellow Tag Stock Feed. Ground barley, ground hominy meal, ground

corn, oat meal mill by-product (oat middlings, shorts and hulls), one-half of one per cent. salt. Part of the ingredients have been cooked or steamed.

Bufceco Poultry Mash. Ground corn, wheat bran and middlings, hominy feed, corn gluten feed, oat middlings, rolled oats, one-half of one per cent. salt.

H.-O. Laying Mash. Linseed oil meal, corn gluten feed, bone meal, ground corn, oat middlings, wheat middlings, wheat bran (with mill run screenings), hominy feed, rolled oats, ground peas.

Tioga Growing Mash. Wheat middlings, hominy feed, old process linseed oil meal, wheat bran, corn feed meal, kaffir corn meal, corn gluten meal, corn gluten feed, phosphate of lime.

Bicorn Hog Feed. Digester tankage, corn germ meal, wheat middlings, hominy feed, corn feed meal, barley, oats, linseed meal, bone meal, corn gluten feed and salt.

Summary of deficiencies. Variations from guaranty greater than one per cent. in protein and fiber and one-quarter of one per cent. in fat together with other points of criticism revealed by the inspection this year are summarized in Table III.

TABLE III.—FEEDS NOT CONFORMING TO GUARANTIES OR OTHERWISE ILLEGAL.

Station No.	Brand and Manufacturer.	Protein deficiency.	Fat deficiency.	Fiber excess.	Remarks.
	Cottonseed Meal.	%	%	%	
3794	Buckeye. Buckeye Cotton Oil Co., Cincinnati, Ohio	....	....	....	Wire tags, illegal.
3904	Clover Leaf. Manufacturer unknown	1.75	....	....	
3873	Hall. W. D. Hall Co., Atlanta, Ga.	....	....	....	Wire tags, illegal.
3864	Quaker Oats Co., Richford, Vt.	5.75	....	4.31	
3931	A-1. Winner Feed Co., Chattanooga, Tenn.	1.44	....	....	
	Cottonseed Feed.				
3788	Beauty. S. P. Davis, Little Rock, Ark.	1.00	....	1.84	
	Linseed Meal.				
3834	Archer Daniels Linseed Co., Buffalo, N. Y.	....	....	...	Wire tags, illegal.
3892	Economic Feed Co., New York	....	1.10	....	Wire tags, illegal.
3783	Kelloggs & Miller, Amsterdam, N. Y.	....	....	....	Wire tags, illegal.
3763	Spencer Kellogg & Sons, Buffalo, N. Y.	2.06	....	....	Wire tags, illegal.
	Wheat Products.				
3823	Bell Cow Bran. Quaker Oats Co., Chicago, Ill.	....	0.37	....	
3791	Tekoe Middlings. Russell Miller Mills Co., Minneapolis, Minn.	....	....	....	No guaranty.
3859	Roberts Roller Mill. Co., Batavia, N. Y.	....	....	....	No guaranty.
	Corn Gluten Feed.				
3804	Cream of Corn. American Maize Products Co., Roby, Ind.	....	....	....	Wire tags, illegal.

TABLE III.—FEEDS NOT CONFORMING TO GUARANTIES OR OTHERWISE ILLEGAL—*Continue*

Station No.	Brand and Manufacturer.	Protein deficiency.	Fat deficiency.	Fibre. excess.	Remarks.
		%	%	%	
	Hominy Feed.				
13910	Bufceco. Buffalo Cereal Co., Buffalo, N. Y...	....	0.40	....	
13779	Yellow. Buffalo Cereal Co., Buffalo, N. Y. ..	....	1.56	....	
13875	Cereal Mills Co., Wausau, Wis.	....	1.20	....	
13835	Paragon. Chas. M. Cox Co., Boston, Mass. ..	....	0.56	....	
13874	National Feed Co., St. Louis, Mo.	....	0.76	....	**Wire tags, illeg**
13790	Burts. Postum Cereal Co., Battle Creek, Mich.	....	0.51	....	
	Brewery Products.				
13846	Dried Brewers' Grains. James Hanley Brewing Co., Providence, R. I.	....	....	....	**Wire tags**, illeg
	Miscellaneous.				
13778	Peanut Meal. Richland Cotton Oil Co., Richland, Ga.	....	....	1.03	
	Proprietary Mixed Feeds.				
13787	Red Horn Calf Meal. Hales & Edwards Co., Chicago, Ill.	....	0.58	....	
13933	Purina Calf Chow. Purina Mills, St. Louis, Mo.	....	1.19	....	
13913	H. & S. Dwight E. Hamlin, Pittsburgh, Pa...	2.56	1.96	....	
13848	Harvest. Hales & Edwards Co., Chicago, Ill.	....	0.31	....	
13831	Monogram. Metropolitan Mills, New York ..	3.31	1.12	....	
13919	Mystic. Mystic Milling & Feed Co., Rochester, N. Y.	...	....	1.41	Wire tags, illeg
13747	Emerald. Prairie State Milling Co., Chicago, Ill.	....	0.60	3.23	
13854	Purina Pig Chow. Purina Mills, St. Louis, Mo.	....	....	1.77	
13923	Niagara. Boston Feed Store, Willimantic ...	....	....	....	No guaranty.
13906	Yellow Tag Stock Feed. F. L. Cressey, Boston, Mass.	....	....	1.17	
13867	Iowa. Purity Oats Co., Davenport, Iowa	....	0.26	....	
13751	Schumacker. Quaker Oats Co., Chicago, Ill...	....	0.26	....	
13842	Winner. David Stott, Detroit, Mich.	....	0.60	....	
13768	Provender. D. L. Talcott, Torrington	....	....	....	No guaranty.
13927	Niagara. Boston Feed Store, Willimantic	....	....	....	No guaranty.
13749	H. O. Milk Feed. H. O. Co.'s Mills, Buffalo, N. Y.	....	0.49	....	
13813	Read the Tag. H. O. Co.'s Mills, Buffalo, N. Y.	....	0.51	....	
13757	Gold Flake. Hales & Edwards Co., Chicago, Ill.	1.50	0.50	....	
13830	Barfords. Meech & Stoddard, Inc., Middletown	....	0.71	....	
13868	Purina Cow Chow. Purina Mills, St. Louis, Mo.	....	0.49	....	
13780	Syragold. Syracuse Milling Co., Syracuse, N. Y.	....	0.41	....	
	Poultry Feeds.				
13881	Buffalo Laying Mash. Globe Elevator Co., Buffalo, N. Y.	....	3.58	....	
13786	Red Comb Mash Feed. Hales & Edwards Co., Chicago, Ill.	....	0.42	....	

Feeds Containing Molasses. As in previous years feeds containing molasses have been examined for fat both by the official method and by extraction after removing sugar by washing with water.

Results by the two methods are as follows:

TABLE IV. FAT IN MOLASSES FEEDS.

No.	Brand.	Official Method. %	Modified Method. %	Guaranty. %
13743	Peters King Corn Horse and Mule Feed	0.77	1.47	1.50
13747	Emerald Horse Feed	0.61	1.40	2.00
13762	Purina Molene Feed	4.60	3.64	3.20
13765	Eshelman's 40 Horse Feed	2.06	2.16	2.00
13811	Greenfield Brand	0.45	0.94	0.50
13826	Allstock Molasses Grains	2.34	3.18	2.00
13831	Monogram Feed	1.22	1.88	3.00
13833	Bufceco Horse Feed	4.69	3.52	4.00
13848	Harvest Horse Feed	1.39	1.69	2.00
13871	Lancaster Horse Feed	2.63	2.70	2.50
13895	Harvest Horse Feed	1.29	2.03	2.00
13912	Sucrene Dairy Feed	3.91	4.39	3.50
13913	H. & S. Horse, Mule and Dairy Feed	0.90	1.54	3.50
13919	Mystic Feed, Horse, Cattle & Swine	3.99	2.77	3.00

In eleven cases the results after removing sugar were higher than those by the regular official method; in three cases they were lower.

MISCELLANEOUS SAMPLES.

VELVET BEANS.

Analyses have been made of three of the principal varieties of velvet beans, samples of which were obtained through the courtesy of the Bureau of Plant Industry at Washington.

Variety	Osceola. %	Alabama. %	Georgia. %
Moisture	9.79	7.42	7.73
Ash	3.22	3.22	3.02
Protein (N. x 6.25)	25.25	24.81	23.85
Fiber	5.65	5.35	6.72
Starch	32.50	32.88	32.02
Other nitrogen-free extract	19.29	20.03	20.61
Ether extract	4.30	6.29	6.05

Samples Submitted by the Dairy Commissioner.

Two samples were examined; **12523**, Morgan B Stock Feed, and **15954**, Brewers' Grains, contained 15.63 per cent. and 17.31 per cent. of protein, respectively. These numbers are of the Commissioner's series.

Samples Submitted by Individuals.

Barley Feed. **13382**, sent by E. Manchester and Sons, Winsted, contained 12.25 per cent. protein, 10.25 per cent, fiber and 3.86 per cent. fat and conformed to its guaranty.

Corn Products. **13404**, Fancy Cracked Corn (degerminated), manufactured by the Krause Milling Co. and sent by Chas. M. Cox Co., Boston.

13399, Corn Meal, sent by A. B. Congdon, Middletown.

14243, Gluten Feed, sent by Frank C. Beach, New Milford.

12368, Hominy Feed, sent by The P. Schwartz Co., Inc., New London.

14390, Corn and Cob Meal, sent by A. Bender, Port Chester, N. Y.

Analyses of these materials are as follows:

	13404	13399	14243	12368	14390
Moisture	12.93	....	5.78	....	....
Ash	0.39	....	3.43	....	....
Protein	8.88	13.25	27.38	11.19	8.63
Fiber	0.26	....	5.64	....	....
Nitrogen-free extract	77.24	....	54.48	....	....
Fat	0.30	....	3.29	....	....

Cottonseed Meal. **12381, 12946**, American Cotton Oil Co.; **12436, 12739**, Park and Pollard Co.; **12603**, Deutsch & Sickert Co.; **12738**, E. Crosby & Co., all sent by The Coles Company, Middletown.

12467, sent by E. J. Wells, Jr., East Windsor Hill.

13160, Pioneer, sent by Wood Ford Farm, Avon.

13512, Danish, sent by Wm. E. Wheelock, Quinebaug; **14180**, sent by Humphreys-Goodwin Co., the same being a portion of a sample taken by Mr. Wheelock from the same lot as sample **13512** and sent by him to them at their request.

14303, sent by H. H. McKnight, Ellington.

Analyses of these samples are as follows:

Station No.	Protein found.	Protein guaranteed.
	%	%
12381	35.81	36.00
12946	36.63	36.00
12436	40.94	36.00
12739	35.00	36.00
12603	36.81	36.00
12738	31.75	36.00
12467	43.44	Unit basis
13160	40.44	41.00
13512	34.31	36.00
14180	36.31	....
14303	35.31	....

A recheck on our sample **13512**, made in this laboratory, substantiated our original result.

Oat Products. **12605**, Ground Oats, sent by B. W. Ellis, County Agent, Putnam, and **13629**, sent by Almon N. Perkins, Litchfield, contained 11.63 per cent. and 14.00 per cent. protein respectively.

Wheat Products. **13383**, Big Diamond Standard Middlings, sent by Henry Peacock, Wilton, contained 15.75 per cent. protein, 8.05 per cent. fiber and 5.20 per cent. fat. The sample conformed to its guaranty.

12920, Middlings, sent by M. Hurwitz & Co., Stepney, to be examined for foreign material. Examination showed no material other than wheat products.

Proprietary Mixed Feeds. **14244**, Dairy Feed, sent by Frank C. Beach, New Milford.

14392, Eshelman's 24 Dairy Feed, sent by Fairlea Farm, Orange.

12282, Federal Stock Food, sent by Frank S. Platt Co., New Haven.

12462, Stock Feed, sent by C. A. Cowles, Plantsville.

12497, Sweet Stock Feed, made by Metropolitan Mills, N. Y., composed of unground oat feed, cocoanut oil meal, dried brewers' grains and molasses.

12546, W. & C. Dairy Feed, mixed and sent by Boston Grain Store, Willimantic.

12702, Davis Stock Feed, mixed and sent by R. G. Davis and Sons, New Haven.

13395, Ideal Cow Ration, sent by Washington Supply Co., Inc., Washington Depot.

12887, Barford's Balanced Dairy Ration, sent by Meech and Stoddard, Inc., Middletown, composed of ground oats, barley, wheat bran, standard middlings, gluten feed, peanut, cocoanut and linseed meals.

14027, Barford's Balanced Dairy Ration, sent by Connecticut State Hospital, Middletown.

14236, Barford's Balanced Dairy Ration, sent by Meech and Stoddard, Inc., Middletown.

12474, Morgan's Balanced Ration, sent by The Hubbell Coal and Storage Co., Saugatuck.

14340, Morgan's Balanced Ration, sent by The A. E. Plant Sons Co., Branford.

14245, Dairy Ration, sent by Mrs. I. E. Bauch, Woodbury.

12185, Dairy Feed, sent by R. M. Fenn, Middlebury.

14388, Holsum Horse Feed, and **14389**, King Corn, sent by Lewis Sperry, Hartford.

12883, Special Mixture. Analysis requested by J. P. Stillson, New Preston.

12746, sent by G. W. Thorpe, West Cheshire.

12307, sent by Daniel H. Morgan, Southport.

Analyses of these feeds are as follows:

TABLE V. ANALYSES OF MISCELLANEOUS PROPRIETARY FEEDS.

Station No.	Moisture.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
	%	%	%	%	%	%
14244	6.31	5.18	21.94	9.66	51.45	5.46
14392	6.91	6.30	24.06	11.14	45.87	5.72
12282	12.98	....	7.06	....	....	5.25
12462	9.12	3.83	7.81	13.52	62.69	3.03
12497	5.53	7.61	7.13	13.70	64.06	1.97
12546	6.99	....	17.88	....	....	4.01
12702	8.32	....	10.94	....	....	4.09
13395	11.92	4.02	21.13	8.13	49.79	5.01
12887	10.80	4.94	20.00	7.50	50.25	6.51
14027	6.84	4.86	20.50	8.64	52.14	7.02
14236	9.60	5.18	21.25	10.91	47.78	5.28
12474	5.52	7.04	15.75	14.04	46.73	10.92
14340	....	....	22.31	....	....	....
14245	8.83	5.07	20.75	16.97	43.83	4.55
12185	7.39	7.06	22.25	11.33	47.38	4.59
14388	5.20	7.80	10.13	14.97	60.19	1.71
14389	5.04	7.88	11.88	15.25	58.00	1.95
12883	10.39	4.66	22.50	9.14	48.23	5.08
12746	7.06	....	18.94	....	....	9.00
12307	....	....	18.06	....	....	....

Poultry Feeds, etc. **13412,** Meat Meal, and **13413,** Meat Scrap, sent by Z. N. Beach, Wallingford, contained 83.75 per cent. and 50.00 per cent. protein respectively.

13033, 13034, 13035, Beef Scraps, and **13036,** Meat and Bone Scraps, sent by L. C. Orcutt, Rockville, contained 44.63 per cent., 43.38 per cent., 57.00 per cent., and 41.00 per cent. protein in the order named.

12472, Dry Mash, sent by S. M. Crowell, Middletown, contained 23.19 per cent. protein.

Unclassified. **13351,** Extravim Feed Molasses, sent by E. D. Curtis, Bantam. Examination and analysis of this material showed the following results:

Color, very dark; odor and taste normal; total solids 71.14 per cent.; total reducing sugar 50.85 per cent. (sucrose 30.63 per cent., invert sugar 20.22 per cent.); nitrogen 1.39 per cent.

The material is probably the so-called "third molasses" obtained in the manufacture of sugar and used in the preparation of molasses feeds.

14171, Cull beans, sent by Edw. P. Smith and Co., Baltimore. They contained 8.86 per cent. moisture, 5.33 per cent. ash, 25.13 per cent. protein, 3.99 per cent. fiber, 55.00 per cent. nitrogen-free extract and 1.69 per cent. fat.

Proprietary Remedies. **13648,** More Egg Tonic, 2-4-1, and **13649,** Little Champions, a White Diarrhoea Remedy, both samples sent by the Associated Advertising Clubs of the World, New York.

More Egg Tonic is claimed to increase or double egg production; and Little Champions are claimed to be a preventative and cure for white diarrhoea in chicks.

Examination and analysis of these remedies showed the following composition:

13648. Tablets averaged 0.4780 gram each. Total nitrogen 1.36 per cent.; nitrogen in nitrates 1.03 per cent.; total ash 18.95 per cent. (contains chiefly sulphates, potassium, iron and calcium); fenugreek present; ginger present; possibly gentian.

The tablets consist essentially of ferrous sulphate, salt peter and ground roots or herbs or both, ingredients which are widely used in poultry remedies and conditioners.

13649. Tablets averaged 0.1689 gram each. Ash 0.14 per cent.; organic and volatile 99.86 per cent.; mercuric chloride 60.65 per cent.; filler undetermined; organic matter present.

These tablets contain bichloride of mercury as the chief medicament with unidentified organic material probably used as a vehicle.

A great deal of study has been given to the subject of white diarrhoea at the Storrs Station where the bacterium causing the disease was discovered. There is no recognized cure for it and the claims made for this remedy are unjustified.

Feeds suspected of containing poisonous materials, etc. Complaints are occasionally received that certain feeds have apparently produced sickness or death, or that animals refuse to eat them. Conclusive evidence that sickness or death has resulted from a particular feed is difficult to establish, although the circumstances may strongly indicate such conclusions in some cases. Unless toxic chemical substances can be detected a satisfactory explanation as to the probable cause of the trouble can seldom be given. Feeding experiments, particularly in Canada, have shown quite conclusively that certain weed seeds, such as the mustards, produce ill or fatal results in animals, especially hogs. A refusal to eat a certain ration may indicate the presence of some unpalatable ingredient. Velvet beans, for example, are not relished by animals unaccustomed to such fodder.

Eight samples of suspicious feeds have been examined during the past year. In six of these unpalatability due to some ingredient to which the animals were not accustomed seemed to be the only explanation that could be made. **12775**, Starch Feed, containing "lumps," was sent for identification of the foreign material. The "lumps" were rock phosphate. **12856**, Middlings, suspected of containing foreign material, appeared to be a genuine wheat product.

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	OIL SEED PRODUCTS.	
	Cottonseed Meal.	
13898	Paramount. Ashcraft Wilkins Co., Atlanta, Ga.	Middletown: Meech & Stc dard, Inc. ....
		Guaranty ....
13879	Dove. F. W. Brode & Co., Memphis, Tenn. ..	Brookfield: C. R. Dubia ..
		Guaranty ....
13872	Jay. F. W. Brode & Co., Memphis, Tenn.	Stamford: C. E. Slauson (
		Guaranty ....
13934	Jay. F. W. Brode & Co., Memphis, Tenn.	Rockville: Rockville Milli Co. ....
		Guaranty ....
13794†	Buckeye. Buckeye Cotton Oil Co., Cincinnati, Ohio	Granby: E. H. Rollins ...
		Guaranty ....
13889	Good Luck. S. P. Davis, Little Rock, Ark. ...	New Milford: Geo. E. Ack Co. ....
		Guaranty ....
13873†	Hall. W. D. Hall Co., Atlanta, Ga.	Stamford: W. L. Crabb .
		Guaranty ....
13744	Danish. Humphreys, Godwin Co., Memphis, Tenn.	Shelton: Ansonia Flour Grain Co. ....
		Guaranty ....
13904	Clover Leaf. Manufacturer unknown	Middletown: Meech & St dard, Inc. ....
		Guaranty ....
13756	Upland. Park & Pollard Co., Boston, Mass. ..	Watertown: M. D. Leon Co. ....
		Guaranty ....
13864	Quaker Oats Co., Richford, Vt.	Saugatuck: Hubbell Coal Storage Co. ....
		Guaranty ....
13817	Puritan. J. E. Soper Co., Boston, Mass.	Plantsville: C. A. Cowles
		Guaranty ....
13803	Good. Taylor Commission Co., Atlanta, Ga. ..	Hazardville: A. D. Brid Sons ....
		Guaranty ....
13852	Surety. Union Seed & Fertz. Co., Macon, Ga.	Meriden: Meriden Grain Feed Co. ....
		Guaranty ....
13931	A-1. Winer Feed Co., Chattanooga, Tenn. ...	New Haven: R. G. Davi Sons ....
		Guaranty ....
		Average guaranty ....
		Average of analyses .....
		Average digestible ....
	Cottonseed Feed.	
13870	Goodlow. M. F. Baringer, Philadelphia, Pa. ..	South Norwalk: S. Rood
		Guaranty ....

† Wire tags.

INSPECTION OF 1919.

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
3898	6.74	6.18	39.13	12.11	29.18	6.66	$84.00
....	....	....	36.00	14.00	27.00	5.50	....
3879	7.30	6.55	40.19	11.59	27.66	6.71	87.00
....	....	....	38.63	12.00	22.00	6.00	....
3872	5.78	6.55	37.94	10.86	31.22	7.65	84.00
....	....	....	36.00	14.00	30.00	5.00	....
3934	7.59	6.35	36.06	12.41	31.44	6.15	83.00
....	....	....	36.00	14.00	30.00	5.00	....
3794	7.01	5.65	36.19	12.46	31.56	7.12	82.00
....	....	....	36.00	14.00	30.00	5.00	....
3889	8.00	6.90	43.63	9.65	23.62	8.20	88.00
....	....	....	41.00	9.00	....	6.00	....
3873	7.95	6.05	37.88	12.95	29.29	5.88	70.00
....	....	....	36.00	14.00	27.00	5.50	....
3744	7.40	6.53	36.38	11.22	31.18	7.29	86.00
....	....	....	36.00	15.00	25.00	5.00	....
3904	7.55	6.17	34.25	12.92	31.78	7.33	84.00
....	....	....	36.00	....	....	5.00	....
3756	6.89	5.83	34.69	15.81	31.42	5.36	82.00
....	....	....	36.00	....	....	5.00	....
3864	8.70	5.31	30.25	18.31	32.20	5.23	85.00
....	....	....	36.00	14.00	27.00	5.00	....
3817	7.29	6.13	39.69	10.96	28.63	7.30	82.00
....	....	....	36.00	15.00	30.00	5.00	....
3803	7.28	6.00	37.94	11.96	29.88	6.94	80.00
....	....	....	36.00	....	....	7.00	....
3852	7.95	5.63	37.75	11.98	30.10	6.59	80.00
....	....	....	36.00	14.00	27.00	5.50	....
3931	6.99	5.78	34.56	13 94	31.72	7.01	83.00
....	....	....	36.00	14.00	27.00	5.50	....
....	....	....	36.51	....	....	5.37	....
....	7.36	6.11	37.10	12.61	30.06	6.76	82.67
....	....	....	31.2	4.7	22.5	6.4	....
3870	7.42	5.89	36.38	12.47	31.22	6.62	84.00
....	....	....	36.00	16.00	....	5.00	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	OIL SEED PRODUCTS—*Concluded.* *Cottonseed Feed—Concluded.*	
13788	Beauty. S. P. Davis, Little Rock, Ark.	Simsbury: Woods-Chandler Co.
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Linseed Meal, Old Process.	
13816	Oil Meal. American Linseed Co., New York	Plantsville: C. A. Cowles
		Guaranty
13822	Amco. American Milling Co., Peoria, Ill.	West Cheshire: G. W. Thorpe
		Guaranty
13834†	Ground Oil Cake. Archer Daniels Linseed Co., Buffalo, N. Y.	Thompsonville: George S. Phelps Co.
		Guaranty
13892†	Economic Feed Co., New York	Hamden: I. W. Beers
		Guaranty
13783†	Oil Meal. Kelloggs & Miller, Amsterdam, N. Y.	Canaan: Ives & Pierce
		Guaranty
13763†	Oil Meal. Spencer Kellogg & Sons, Buffalo, N. Y.	Torrington: D. L. Talcott
		Guaranty
13893	Oil Meal. The Mann Bros. Co., Buffalo, N. Y.	Branford: S. V. Osborne
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	WHEAT PRODUCTS. *Wheat Bran.*	
13849*	Commander. Commander Mill. Co., Minneapolis, Minn.	New Britain: C. W. Lines Co.
		Guaranty
13795*	Fancy. C. C. Davison, Geneva, N. Y.	West Suffield: S. J. Orr
		Guaranty
13829	Gwinn's. Gwinn Milling Co., Columbus, Ohio.	Hartford: Meech Grain Co.
		Guaranty
13746*	Wm. Hamilton & Son, Honeoye Falls, N. Y.	Derby: Peterson-Hendee Co.
		Guaranty
13844*	The Hogan Milling Co., Junction City, Kans.	Manchester: Little & McKinney
		Guaranty
13857*	Hunter Milling Co., Wellington, Kans.	Wallingford: E. E. Hall
		Guaranty
13886	Majestic Milling Co., Aurora, Mo.	New Milford: Geo. T. Soule
		Guaranty
13771	Ogilvie Flour Mill. Co., Winnipeg, Canada	Torrington: F. L. Wadhams & Son

INSPECTION OF 1919—*Continued.*

Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	Price per ton.
			Pounds per Hundred.			
7.66	5.90	35.00	15.84	29.58	6.02	$80.00
....	....	36.00	14.00	....	6.00	....
....	....	36.00	15.00	....	5.50	....
7.54	5.90	35.69	14.16	30.39	6.32	82.00
....	....	20.8	6.4	18.5	5.7	....
8.13	5.76	34.50	7.38	38.00	6.23	82.00
....	....	34.00	....	....	5.00	....
8.59	6.46	30.50	8.71	37.99	7.75	86.00
....	....	30.00	....	....	6.00	....
9.09	5.76	33.75	7.29	37.60	6.57	82.00
....	....	33.00	10.00	....	6.00	....
9.50	5.73	33.44	8.27	36.16	6.90	89.00
....	....	33.00	10.00	....	8.00	....
8.15	6.15	31.44	7.55	40.98	5.73	84.00
....	....	31.00	9.00	....	4.00	....
9.60	6.21	30.94	7.77	39.43	6.05	82 00
....	....	33.00	....	....	5.00	....
9.93	5.82	35.19	7.77	34.22	7.07	93.00
....	....	33.00	10.00	....	6.00	....
....	....	32.83[1]	....	....	6.16[1]	....
8.99	5.98	32.82	7.82	37.78	6.61	85.42
....	....	29.2	4.5	29.5	5.9	....
9.94	6.83	14.75	11.06	52.82	4.60	50.00
....	....	12.00	....	....	4.00	....
9.18	7.15	15.69	10.17	53.58	4.33	72.00
....	....	15.00	....	....	4.00	....
9.05	6.10	16.13	8.49	56.16	4.07	51.00
....	....	13.00	....	....	4.00	....
10.06	6.73	14.69	9.76	54.70	4.06	52.00
....	....	13.15	10.97	....	3.00	....
9.86	6.33	15.69	9.95	53.62	4.55	52.00
....	....	14.50	11.00	....	3.50	....
10.14	6.94	15.75	10.76	52.05	4.36	48.00
....	....	14.50	....	....	3.50	....
9.69	5.73	16.31	8.92	55.25	4.10	50.00
....	....	14.00	14.00	50.00	3.75	....
8.95	6.10	17.50	10.08	51.64	5.73	52.00
[illegible]	[illegible]	[illegible]	[illegible]	....	4.00	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Continued.* *Wheat Bran—Concluded.*	
13929	Phoenix Milling Co., Davenport, Iowa	Rockville: Rockville Milling Co. ....
		Guaranty ....
13894	Winter. Quaker City Flour Mills Co., Philadelphia, Pa.	Guilford: Morse & Landon..
		Guaranty ....
13823*	Bell Cow. Quaker Oats Co., Chicago, Ill.	West Cheshire: G. W. Thorpe
		Guaranty ....
13839*	T. & C. Thornton and Chester Milling Co., Buffalo, N. Y.	Thompsonville: George S. Phelps & Co. ....
		Guaranty ....
13907*	Sun Beam. Schultz, Baujan & Co., Beardstown, Ill.	New London: P. Schwartz Co. ....
		Guaranty ....
13807*	Geo. Urban Milling Co., Buffalo, N. Y.	Unionville: F. D. Lawton ...
		Guaranty ....
13858*	Valier's. Valier & Spies Milling Co., St. Louis, Mo.	North Haven: Coöperative Feed Co. ....
		Guaranty ....
13750*	Washburn-Crosby Co., Minneapolis, Minn.	Ansonia: Ansonia Flour & Grain Co. ....
		Guaranty ....
		Average guaranty ....
		Average of analyses ....
		Average digestible ....
	Wheat Feed (Mixed Feed).	
13775	Boston. Duluth Superior Milling Co., Duluth, Minn.	Winsted: E. Manchester & Sons ....
		Guaranty ....
13824	Frazee's. James Frazee Mill. Co., Baldwinsville, N. Y.	West Cheshire: G. W. Thorpe
		Guaranty ....
13748	Snow Flake. Lawrenceburg Flour Mills Co., Lawrenceburg, Ind.	Ansonia: Ansonia Flour & Grain Co. ....
		Guaranty ....
13761	Planet. Northwestern Consolidated Co., Minneapolis, Minn.	Litchfield: The Wadhams Co.
		Guaranty ....
13888*	Fancy. Pillsbury Flour Mills Co., Miinneapolis, Minn.	New Milford: Geo. E. Ackley Co. ....
		Guaranty ....
13820*	Fancy. Pillsbury Flour Mills Co., Minneapolis, Minn.	Plantsville: C. A. Cowles ...
		Guaranty ....
13843*	Buckeye. Quaker Oats Co., Chicago, Ill.	Manchester: Little & McKinney ....
		Guaranty ....
13793	Occident. Russell Miller Mills Co., Minneapolis, Minn.	Granby: E. H. Rollins ......
		Guaranty ....

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred. Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	Price per ton.
3929	10.28	6.55	16.44	9.26	53.38	4.09	$56.00
....	....	....	14.31	....	....	3.73	....
3894	10.03	6.50	16.06	9.54	53.62	4.25	52.00
....	....	....	13.00	....	....	3.00	....
3823	8.38	5.75	16.13	9.71	54.90	5.13	48.00
....	....	....	15.30	7.60	56.00	5.50	....
3839	8.20	6.60	15.19	9.95	55.63	4.43	50.00
....	....	....	14.00	....	....	4.00	....
3907	9.54	7.90	15.19	11.34	51.33	4.70	50.00
....	....	....	15.00	10.00	56.00	3.50	....
3807	9.24	6.83	15.19	10.43	53.22	5.09	48.00
....	....	....	14.00	12.50	....	3.50	....
3858	9.72	6.55	17.81	9 77	51.30	4.85	48.00
....	....	....	14.50	10.00	50.00	3.50	....
3750	9.46	6.88	15.38	9.81	53.65	4.82	49.00
....	....	....	13.00	....	....	4.00	....
....	....	....	13.89	....	....	3.78	....
....	9.42	6.59	15 87	9.94	53.61	4.57	51.75
....	....	....	12.0	4.3	40.3	2.8	....
3775	10.02	4.63	17.06	8.72	53.94	5.63	61.00
....	....	....	15.00	....	....	4.00	....
3824	9.54	5.23	16.19	7.18	57.08	4.78	61.00
....	....	....	14.00	12.00	....	3.50	....
3748	9.65	6.09	17.94	7.89	53.90	4.53	59.00
....	....	....	14.00	....	....	3.00	....
3761	10.24	5.00	17.88	5.88	55.69	5.31	60.00
....	....	....	15.00	....	....	4.00	....
3888	9.97	4.91	17.06	7.08	56.59	4.39	62.00
....	....	....	14.00	....	....	4.00	....
3820	9.78	4.91	17.00	8.07	55.48	4.76	58.00
....	....	....	14.00	....	....	4.00	....
3843	9.05	5.85	16.75	8.64	54.69	5.02	59.00
....	....	....	15.50	....	....	4.50	....
3793	9.34	5.50	16.69	8.41	54.30	5.76	58.00
....	....	....	15.00	....	....	4.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Continued.*	
	Wheat Feed (Mixed Feed)—Concluded.	
13752	Gold Mine. Sheffield King Milling Co., Minneapolis, Minn.	Waterbury: Spencer Grain Co.
		Guaranty
13769	Stott's Honest. David Stott's Flour Mills, Detroit, Mich.	Torrington: F. L. Wadhams & Son
		Guaranty
13850*	Angelus. Thompson Milling Co., Lockport, N. Y.	New Britain: C. W. Lines Co.
		Guaranty
13837*	T. & C. Thornton & Chester Milling Co., Buffalo, N. Y.	Thompsonville: George S. Phelps & Co.
		Guaranty
13914*	Victor. Victor Milling Co., Victor, N. Y.	Norwich: Chas. Slosberg & Son
		Guaranty
13812*	Washburn-Crosby Co., Minneapolis, Minn.	Plainville: Eaton Bros.
		Guaranty
13777	Kent. Williams Bros. Co., Kent, Ohio	Winsted: E. Manchester & Son
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
	Wheat Middlings.	
13877	Bay State. Bay State Milling Co., Winona, Minn.	Danbury: F. C. Benjamin
		Guaranty
13796	Fancy. C. C. Davison, Geneva, N. Y.	West Suffield: S. J. Ora
		Guaranty
13745	Wm. Hamilton & Son, Honeoye Falls, N. Y.	Derby: Peterson-Hendee Co.
		Guaranty
13791	Tekoe Flour Middlings. Russell Miller Mills Co., Minneapolis, Minn.	Granby: E. H. Rollins
		Guaranty
13838	Choice. Niagara Milling Co., Niagara Falls, N. Y.	Thompsonville: George S. Phelps Co.
		Guaranty
13930	Shorts. Phoenix Milling Co., Davenport, Iowa	Rockville: Rockville Milling Co.
		Guaranty
13827	B. Pillsbury Flour Mills Co., Minneapolis, Minn.	Hartford: Meech Grain Co.
		Guaranty
13841	XX Daisy. Pillsbury Flour Mills Co., Minneapolis, Minn.	So. Manchester: G. W. Strant
		Guaranty
13782	Quaker City. Quaker City Flour Mills Co., Philadelphia, Pa.	Canaan: Ives & Pierce
		Guaranty
13859	Roberts Roller Mill Co., Batavia, N. Y.	North Haven: Coöperative Feed Co.
		Guaranty

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13752	9.45	5.50	15.63	8.12	56.68	4.62	$75.00
....	....	....	15.00	....	....	4.50	....
13769	9.96	5.28	16.75	7.70	55.59	4.72	61.00
....	....	....	15.00	....	....	4.00	....
13850	9.27	5.90	16.81	8.66	54.73	4.63	63.00
....	....	....	11.00	....	....	3.00	....
13837	8.95	5.93	16.69	9.66	53.49	5.28	58.00
....	....	....	14.00	....	....	4.50	....
13914	10.92	5.03	17.00	7.54	54.56	4.95	55.00
....	....	....	15.00	....	....	4.50	....
13812	9.03	6.10	15.88	8.43	56.25	4.31	65.00
....	....	....	14.00	....	....	4.00	....
13777	9.55	5.55	16.19	7.19	56.68	4.82	62.00
....	....	....	14.00	....	....	3.00	....
....	....	....	14.30	....	....	3.93	....
....	9.65	5.43	16.77	7.94	55.31	4.90	61.13
....	....	....	12.9	2.9	42.0	4.3	....
13877	11.05	4.18	17.25	6.60	56.06	4.86	68.00
....	....	....	15.00	....	....	4.00	....
13796	8.92	5.25	18.06	5.77	56.99	5.01	78.00
....	....	....	15.00	....	....	4.50	....
13745	10.07	4.40	18.38	4.46	56.88	5.81	68.00
....	....	....	14.80	....	....	5.30	....
13791	10.37	1.60	17.31	1.03	66.43	3.26	80.00
....	....	....	....	....	....	....	....
13838	9.83	4.60	17.81	7.13	55.21	5.42	64.00
....	....	....	14.00	....	....	4.00	....
13930	10.95	4.63	17.56	5.49	56.49	4.88	61.00
....	....	....	16.50	....	....	4.30	....
13827	8.69	6.68	16.38	10.13	53.87	5.25	66.00
....	....	....	14.00	....	....	4.00	....
13841	11.10	2.90	17.38	3.07	61.53	4.02	78.00
....	....	....	15.00	....	....	4.00	....
13782	9.05	4.40	18.56	5.62	57.11	5.26	69.50
....	....	....	14.00	....	....	4.00	....
13859	9.86	4.45	21.81	6.03	53.39	4.46	66.00
....	....	....	....	....	....	....	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	WHEAT PRODUCTS—*Concluded.*	
	Wheat Middlings—Concluded.	
13809*	Washburn Mills, Minneapolis, Minn.	Plainville: Eaton Bros. ....
		Guaranty ....
13924	Shorts. Weber Flour Mills Corp., Salina, Kans.	Willimantic: Boston Fee Store ....
		Guaranty ....
		Average guaranty ....
		Average of analyses ....
		Average digestible ....
	RYE PRODUCTS.	
13825	Feed. Boutwell Mill & Grain Co., Troy, N. Y.	West Cheshire: G. W. Thorp
		Guaranty ....
13776	Middlings. Northland Rye Mills Co., Minneapolis, Minn.	Winsted: E. Manchester & Sons ....
		Guaranty ....
13819	True Value Middlings. Stratton Ladish Mill. Co., Milwaukee, Wis.	Plantsville: C. A. Cowles ..
		Guaranty ....
	BARLEY PRODUCTS.	
13773	Ground Barley. Albert Dickinson Co., Minneapolis, Minn.	Winsted: E. Manchester & Sons ....
		Guaranty ....
	MAIZE PRODUCTS.	
	Corn Gluten Feed.	
13804†	Cream of Corn. American Maize Products Co., Roby, Ind.	Hazardville: A. D. Bridges Sons ....
		Guaranty ....
13770	Buffalo. Corn Products Refining Co., New York	Torrington: F. L. Wadhams & Son ....
		Guaranty ....
13742	Globe. Corn Products Refining Co., New York	Shelton: Ansonia Flour & Grain Co. ....
		Guaranty ....
13915	Staley's. A. F. Staley Mfg. Co., Decatur, Ill...	Yantic: Yantic Grain & Products Co. ....
		Guaranty ....
		Average guaranty ....
		Average of analyses ....
		Average digestible ....
	Hominy Feed.	
13840	Armour Grain Co., Chicago, Ill.	Hartford: Garber Bros. .....
		Guaranty ....
13855	Spring Garden. Baltimore Pearl Hominy Co., Baltimore, Md.	Wallingford: E. E. Hall ....
		Guaranty ....
13910	Bufceco. Buffalo Cereal Co., Buffalo, N. Y. ..	Mystic: Mystic Grain Co. ...
		Guaranty ....

* With screenings. † Wire tags.

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N.x6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13809	9.00	4.50	17.75	5.09	58.99	4.67	$65.00
....	....	....	15.00	....	....	4.00	....
13924	10.88	4.84	18.00	6.85	55.01	4.42	60 00
....	....	....	16.00	....	....	3.50	....
....	....	....	14.93[1]	....	....	4.16[1]	....
....	9.98	4.29	18.02	5.69	57.34	4.78	68.62
....	....	....	13.9	1.7	44.7	4.2	....
13825	9.09	3.90	16.13	3.88	63.78	3.22	59.00
....	....	....	13.50	....	....	3.00	....
13776	9.58	4.58	16.25	7.39	57.90	4.30	54.00
....	....	....	14.00	....	....	3.00	....
13819	8.61	4 55	17.00	6.06	60.00	3.78	58.00
....	....	....	13.50	....	....	3.00	....
13773	9.67	3.60	12.75	9.05	61.40	3.53	67.00
....	....	....	10.00	8.00	....	2.00	....
13804	7.99	2.03	24.06	6.17	55.94	3.81	78.00
....	....	....	23.00	8.50	....	1.50	....
13770	7.58	4.20	27.63	6.67	49.67	4.25	76.00
....	....	....	23.00	....	....	1.00	....
13742	8.59	3.05	23.31	6.04	57.52	1.49	76.00
....	....	....	23.00	....	....	1.00	....
13915	7.94	4.23	29.30	6.34	49.55	2.64	....
....	....	....	23.00	....	....	2.50	....
....	....	....	23.00	....	....	1.50	....
....	8.02	3.38	26.07	6.31	51.17	3.05	76.66[2]
....	....	....	22.1	4.8	46.8	2.6	....
13840	7.54	2.55	11.50	5.13	65.87	7.41	70.00
....	....	....	10.00	....	....	5.00	....
13855	8.30	3.33	12.00	8.55	61.93	5.89	63.00
....	....	....	10.00	6.00	....	5.00	....
13910	9.71	2.52	12.13	3.87	66.17	5.60	63.00
....	....	....	10.00	4.00	....	6.00	....

[1] Average of ten guaranties. [2] Average of three prices.

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	MAIZE PRODUCTS—*Concluded.* *Hominy Feed—Concluded.*	
13779	Yellow. Buffalo Cereal Co., Buffalo, N. Y. ...	Winsted: E. Manchester & Sons ......
		Guaranty ......
13875	Cereal Mills Co., Wausau, Wis.	Ridgefield: S. D. Keeler ...
		Guaranty ......
13835	Paragon. Chas. M. Cox Co., Boston, Mass. ...	Thompsonville: George S Phelps & Co. ......
		Guaranty ......
13891	Emco. Evans Milling Co., Indianapolis, Ind. ..	Hamden: I. W. Beers .....
		Guaranty ......
13774	Miller Cereal Mills, Omaha, Neb.	Winsted: E. Manchester & Sons ......
		Guaranty ......
13828	Choice Steam Cooked. Miner-Hillard Milling Co., Wilkesbarre, Pa.	Hartford: Meech Grain Co.
		Guaranty ......
13874†	National Feed Co., St. Louis, Mo.	Stamford: W. L. Crabb ...
		Guaranty ......
13790	Burts. Postum Cereal Co., Battle Creek, Mich.	Granby: E. H. Rollins .....
		Guaranty ......
13805	Yellow. Quaker Oats Co., Chicago, Ill.	Unionville: F. D. Lawton ..
		Guaranty ......
13883	True Value. Stratton Ladish Milling Co., Milwaukee, Wis.	New Milford: Geo. T. Soul
		Guaranty ......
13815	Wathen Milling Co., Louisville, Ky.	Bristol: Goodsell Bros. ....
		Guaranty ......
		Average guaranty ......
		Average of analyses ......
		Average digestible ......
	Dried Corn Flake Feed.	
13865	Kellogg Toasted Corn Flake Co., Battle Creek, Mich.	Saugatuck: Hubbell Coal & Storage Co. ......
		Guaranty ......
	BREWERY PRODUCTS.	
13846†	Dried Brewers' Grain. James Hanley Brewing Co., Providence, R. I.	Rockville: Rockville Grain & Coal Co. ......
		Guaranty ......
13758	Dried Brewers' Grain. Providence Brewing Co., Providence, R. I.	Thomaston: Thomaston Grain & Coal Co. ......
		Guaranty ......
		Average guaranty ......
		Average of analyses ......
		Average digestible ......
	MISCELLANEOUS FEEDS.	
13916‡	Dried Beet Pulp. Continental Sugar Co., Blissfield, Mich.	Yantic: Yantic Grain & Products Co. ......
		Guaranty ......

† Wire tags. ‡ Sold, guaranteed and licensed by the Larrowe Milling Co., Detroit, Mich.

INSPECTION OF 1919—*Continued.*

tion No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N.x6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
779	10.39	1.65	10.50	2.43	70.59	4.44	$72.00
...	....	....	10.00	4.00	65.00	6.00	....
375	10.24	2.60	12.63	3.32	65.41	5.80	75.00
...	8.25	....	10.00	4.00	....	7.00	....
335	8.98	2.85	11.06	3.61	66.56	6.94	68.00
...	....	....	9.50	7.00	60.00	7.50	....
391	9.04	2.80	12.19	5.13	62.28	8.56	71.00
...	....	....	10.00	7.00	....	7.50	....
774	9.69	2.90	11.88	4.58	62.64	8.31	72.00
...	11.00	2.00	10.00	4.00	65.00	8.00	....
328	8.87	2.60	11.25	3.71	67.67	5.90	73.00
...	....	....	10.00	....	....	4.00	....
374	8.74	3.03	13.25	4.63	66.11	4.24	72.00
..	....	....	10.00	10.00	....	5.00	....
90	9.18	2.22	11.00	3.22	68.89	5.49	68.00
..	....	....	10.00	5.00	....	6.00	....
305	9.14	2.95	12.38	4.79	63.94	6.80	68.00
..	....	....	9.00	4.50	....	4.00	....
383	9.10	2.60	11.63	4.56	64.18	7.93	68.00
..	....	....	10.50	5.00	....	5.00	....
315	9.16	2.08	10.38	4.85	67.32	6.21	79.00
..	....	....	10.00	7.00	....	6.00	....
..	....	....	9.21	....	....	5.80	....
..	9.14	2.62	11.70	4.45	65.70	6.39	70.14
..	....	....	7.7	3.6	58.9	5.8	....
65	6.56	3.25	8.06	1.12	79.41	1.60	78.00
..	....	....	6.91	0.42	78.62	2.15	....
46	7.18	4.23	20.50	16.62	44.37	7.10	68.00
..	....	....	20.00	....	....	6.00	....
58	6.82	3.48	27.06	13.57	43.77	5.30	66.00
..	....	....	25.00	....	....	5.00	....
..	....	....	22.50	....	....	5.50	....
..	7.00	3.86	23.78	15.09	40.07	6.20	67.00
..	....	....	19.3	7.4	22.8	5.5	....
16	9.26	4.73	10.00	15.80	59.25	0.96	64.00
..	....	....	8.00	20.00	58.00	0.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	MISCELLANEOUS FEEDS—*Concluded.*	
13832	Dried Beet Pulp. Larrowe Milling Co., Detroit, Mich.	Hartford: C. H. Northa Grain Co.
		Guaranty
13856	Dried Beet Pulp. Larrowe Milling Co., Detroit, Mich.	Wallingford: E. E. Hall
		Guaranty
13905‡	Beet Pulp with Molasses. Mich. Sugar Co., Alma, Mich.	New London: Conn. Gra Corp.
		Guaranty
13885‡	Dried Beet Pulp and Molasses. Mich. Sugar Co., Caro, Mich.	New Milford: Geo. T. Sou
		Guaranty
13908	Dried Beet Pulp. West Bay City Sugar Co., Bay City, Mich.	New London: P. Schwartz C
		Guaranty
		Average guaranty
		Average of analyses
		Average digestible
13754	Cocoanut Meal. Quaker Oats Co., Chicago, Ill.	Waterbury: H. S. Coe & C
		Guaranty
13902	Cocoa Brand Cocoanut Meal. Oil Seed Co., Bayonne, N. J.	Middletown: Meech & Sto dard, Inc.
		Guaranty
13772	Beta Brand Peanut Oil Meal, Oil Seed Co., Bayonne, N. J.	Winsted: E. Manchester Sons
		Guaranty
13778	Pride of Richland Meal (Peanut). Richland Cotton Oil Co., Richland, Ga.	Winsted: E. Manchester Sons
		Guaranty
	PROPRIETARY MIXED FEEDS. *Horse, Dairy and Stock Feeds.*	
13806	Blatchford's Calf Meal. Blatchford Calf Meal Co., Wauregan, Ill.	Unionville: F. D. Lawton
		Guaranty
13787	Red Horn Calf Meal. Hales & Edwards Co, Chicago, Ill.	New Hartford: Case Schwab
		Guaranty
13933	Purina Calf Chow. Purina Mills, St. Louis, Mo.	New Haven: Crittende Benham Co.
		Guaranty
13845	Schumacher's Calf Meal. Quaker Oats Co., Chicago, Ill.	Manchester: Little & M Kinney
		Guaranty
13833	Bufceco Horse Feed. Buffalo Cereal Co., Buffalo, N. Y.	Hartford: C. H. Northa Grain Co.
		Guaranty
13765	Eshelman's 40 Horse Feed. John W. Eshelman & Sons, Lancaster, Pa.	Torrington: D. L. Talcott
		Guaranty
13913	H. & S. Horse, Mule and Dairy Feed. Dwight E. Hamlin, Pittsburgh, Pa.	Norwich: Chas. Slosberg Son
		Guaranty

INSPECTION OF 1919—*Continued.*

ation No.	Pounds per Hundred. Water.	Ash.	Protein. (N.x6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	Price per ton.
832	4.82	3.10	9.25	19.81	62.54	0.48	$68.00
...	....	....	8.00	20.00	58.00	0.50	....
856	5.35	3.55	8.69	20.37	61.56	0.48	62.00
...	....	....	8.00	....	....	0.50	....
905	8.79	4.71	11.19	15.53	58.79	0.99	68.00
...	....	....	9.00	18.00	58.00	0.50	....
885	9.37	3.18	9.31	18.67	58.09	1.38	60.00
...	....	....	9.00	18.00	58.00	0.50	....
908	4.32	3.43	9.94	19.03	62.80	0.48	64.00
...	....	....	8.00	20.00	58.00	0.50	....
...	....	....	8.33	....	....	0.50	....
...	6.98	3.78	9.73	18.20	60.51	0.80	64.33
...	....	....	5.1	13.1	50.2	....	....
754	9.13	6.05	21.06	8.90	47.20	7.66	58.00
...	....	....	20.00	....	....	7.00	....
902	8.25	6.85	26.94	9.77	35.59	12.60	77.00
...	....	....	20.00	10.00	....	7.00	....
772	7.73	5.10	29.63	8.94	36.85	11.75	75.00
...	....	....	30.00	8.00	....	7.00	....
778	7.45	4.74	36.56	23.03	22.16	6.06	81.00
...	....	....	36.00	22.00	23.00	6.00	....
806	8.79	6.26	25.31	7.40	45.33	6.89	105.00
...	....	....	24.00	....	....	5.00	....
787	9.76	4.95	18.06	1.91	60.90	4.42	108.00
...	....	....	18.00	....	....	5.00	....
933	10.02	4.03	28.75	3.23	50.66	3.31	113.00
...	....	....	27.00	....	....	4.50	....
845	7.77	5.36	18.31	2.63	57.99	7.94	110.00
...	....	....	18.00	....	....	4.00	....
833	9.70	3.85	12.50	8.43	60.83	4.69	73.00
...	....	....	10.00	9.00	....	4.00	....
765	8.25	6.66	10.63	17.50	54.80	2.16	64.00
...	....	....	9.00	....	....	2.00	....
913	10.33	10.20	11.44	14.93	51.56	1.54	58.00
...	....	....	14.00	16.00	58.00	3.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Continued.* *Horse, Dairy and Stock Feeds—Continued.*	
13848	Harvest Horse Feed. Hales & Edwards Co., Chicago, Ill.	New Britain: Stanley S Grain Co.
		Guaranty
13895	Harvest Horse Feed. Hales & Edwards Co., Chicago, Ill.	Guilford: Morse & Lando
		Guaranty
13871	Lancaster Horse Feed. Lancaster Milling Co., Lancaster, Pa.	South Norwalk: S. Rood
		Guaranty
13831	Monogram Feed. Metropolitan Mills, New York	Hartford: Meech Grain C
		Guaranty
13919†	Mystic Feed. Horse, Cattle and Swine. Mystic Milling & Feed Co., Rochester, N. Y.	Jewett City: Havens & So
		Guaranty
13743	Peters' King Corn Horse and Mule Feed. M. C. Peters Mill. Co., Omaha, Neb.	Shelton: Ansonia Flour Grain Co.
		Guaranty
13747	Emerald Horse Feed. Prairie State Milling Co., Chicago, Ill.	Derby: Peterson-Hendee
		Guaranty
13811	Greenfield Brand. Prairie State Milling Co., Chicago, Ill.	Plantsville: Eaton Bros.
		Guaranty
13762	Purina Molene Feed. Purina Mills, St. Louis, Mo.	Litchfield: The Wadhams
		Guaranty
13802	Bicorn Hog Feed. Chapin & Co., Hammond, Ind.	Somers: W. C. Everett
		Guaranty
13785	Pioneer Hog Feed. Hales & Edwards, Chicago, Ill.	New Hartford: Case Schwab
		Guaranty
13903	Barford's Ready Ration for Growing Pigs. Meech & Stoddard, Inc., Middletown	Middletown: Meech & St dard, Inc.
		Guaranty
13755	Go-Tu-It Hog Ration. Park & Pollard Co., Boston, Mass.	Waterbury: H. S. Coe &
		Guaranty
13854	Purina Pig Chow. Purina Mills, St. Louis, Mo.	Meriden: August Gru Est.
		Guaranty
13911	Portage Stock Feed. Akron Feed & Milling Co., Akron, Ohio	Norwich: Chas. Slosberg Son
		Guaranty
13861	Armour's Stock Feed. Armour Grain Co., Chicago, Ill.	Southport: C. Buckingha
		Guaranty
13909	Pennant Brand Stock Feed. E. W. Bailey, Swanton, Vt.	Mystic: Mystic Grain Co.
		Guaranty
13923	Niagara Stock Feed. Boston Feed Store, Willimantic	Willimantic: Boston F Store
		Guaranty
13876	Bufceco Chop Feed. Buffalo Cereal Co., Buffalo, N. Y.	Danbury: F. C. Benjamin
		Guaranty
13797	Wirthmore Stock Feed. C. M. Cox Co., Boston, Mass.	Suffield: Spencer Bros.
		Guaranty

† Wire tags.

INSPECTION OF 1919—*Continued.*

tion o.	Pounds per Hundred. Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	Price per ton.
348	7.52	6.85	10.69	20.99	52.26	1.69	$62.00
...	....	....	10.00	....	....	2.00	....
395	10.25	7.00	10.81	13.75	56.16	2.03	63.00
...	....	....	10.00	....	....	2.00	....
371	9.73	5.78	11.31	13.02	57.46	2.70	68.00
..	....	....	10.00	....	....	2.50	....
331	8.43	5.93	10.69	13.10	59.97	1.88	58.00
...	....	....	14.00	....	....	3.00	....
19	8.85	3.90	12.50	10.41	60.35	3.99	58.00
...	....	....	9.00	9.00	....	3.50	....
743	8.99	8.30	12.60	16.81	52.63	1.47	64.00
..	....	....	10.00	....	....	1.50	....
747	8.56	7.63	10.94	15.23	56.24	1.40	58.00
..	....	....	9.00	12.00	....	2.00	....
311	9.99	8.43	10.56	15.81	54.27	0.94	56.00
..	....	....	8.00	....	....	0.50	....
762	8.52	5.33	10.81	9.64	61.10	4.60	72.00
..	....	....	9.70	....	....	3.20	....
302	9.51	4.96	18.81	5.82	56.30	4.60	80.00
..	....	....	17.50	6.00	....	4.50	....
785	9.25	7.58	25.13	6.13	47.04	4.87	78.00
...	....	....	15.00	....	....	4.00	....
03	9.78	4.33	19.75	7.39	52.96	6.79	78.00
...	....	....	18.00	....	....	5.00	....
755	8.12	11.43	18.81	10.76	44.60	6.28	75.00
..	....	....	15.00	....	....	6.00	....
54	11.03	7.50	17.25	10.77	50.56	2.89	81.00
..	....	6.00	15.00	9.00	59.00	2.50	....
11	8.13	3.80	11.75	9.78	61.77	4.77	64.00
..	....	....	8.50	....	....	4.00	....
361	7.30	4.98	13.75	8.86	58.66	6.45	64.00
..	....	....	12.00	....	....	4.00	....
09	7.39	3.75	10.06	9.33	63.74	5.73	67.00
..	....	....	9.00	10.00	....	5.00	....
23	8.16	4.95	13.63	15.28	52.81	5.17	60.00
...	....	....	....	....	....	....	....
376	9.11	4.45	10.06	11.33	61.07	3.98	64.00
..	....	....	8.00	12.00	....	4.00	....
797	8.29	3.68	10.75	7.72	64.50	5.06	68.00
..	....	....	9.00	....	....	4.00	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Continued.* *Horse, Dairy and Stock Feeds—Continued.*	
13906	Yellow Tag Stock Feed. F. L. Cressey, Boston, Mass.	New London: Conn. Gr Corp.
		Guaranty
13926	Crosby's Stock Feed. E. Crosby & Co., Brattleboro, Vt.	Willimantic: Boston F Store
		Guaranty
13764	Stock Feed. John W. Eshelman & Sons, Lancaster, Pa.	Torrington: D. L. Talcott
		Guaranty
13882	No. 1. Chop Feed. Globe Elevator Co., Buffalo, N. Y.	New Milford; G. T. Soul
		Guaranty
13880	Buffalo Chop Feed. Globe Elevator Co., Buffalo, N. Y.	Brookfield: C. R. Dubia .
		Guaranty
13878	Grandin's Stock Feed. D. H. Grandin Mill. Co., Jamestown, N. Y.	Danbury: H. E. Meecker,
		Guaranty
13759	College Stock Feed. Hales & Edwards Co., Chicago, Ill.	Thomaston: Thomas Grain & Coal Co.
		Guaranty
13918	Haven's Stock Feed. Havens & Son, Jewett City	Jewett City: Havens &
		Guaranty
13836	Badger Monopoly Feed. Chas. A. Krause Mill. Co., Milwaukee, Wis.	Thompsonville: George Phelps & Co.
		Guaranty
13896	M. & S. Stock Feed. Meech & Stoddard, Inc., Middletown	Middletown: Meech & St dard, Inc.
		Guaranty
13826	Allstock Molasses Grains. Metropolitan Mills, New York	Hartford: Meech Grain C
		Guaranty
13867	Iowa Stock Feed. Purity Oats Co., Davenport, Iowa	Norwalk: C. E. Slauson
		Guaranty
13751	Schumacker's Stock Feed. Quaker Oats Co., Chicago, Ill.	Waterbury: Spencer Gr Co.
		Guaranty
13860	Victor Feed. Quaker Oats Co., Chicago, Ill.	Milford: E. L. Oviatt
		Guaranty
13920	Vitality Stock Feed. Rosenbaum Bros., Chicago, Ill.	Jewett City: Havens &
		Guaranty
13842	Winner Chop Feed. David Stott's Flour Mills, Detroit, Mich.	Manchester: Little & Kinney
		Guaranty
13890	National Stock Feed. Stratton Ladish Mill. Co., Milwaukee, Wis.	Newtown: Newtown Coa Grain Co.
		Guaranty
13768	Provender. D. L. Talcott, Torrington	Torrington: D. L. Talcott
		Guaranty
13912	Sucrene Dairy Feed. American Milling Co., Peoria, Ill.	Norwich: Chas. Slosberg Son
		Guaranty

INSPECTION OF 1919—*Continued.*

on	Pounds per Hundred. Water.	Ash.	Protein. (N.x6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	Price per ton.
6	9.48	5.03	10.88	10.67	59.35	4.59	$65.00
.	....	....	9.00	9.50	....	4.00	....
5	9.60	3.75	11.25	10.76	60.20	4.44	66.00
.	....	....	9.00	10.00	60 00	4.00	....
4	9.93	4.93	11.81	12.60	56.48	4.25	64.00
.	....	....	10.00	....	....	3.00	....
2	8.92	4.00	10.19	11.62	60.21	5.06	65.00
.	....	....	9.00	....	....	3.00	....
0	10.16	4.25	11.19	11.23	59.60	3.57	66.00
.	....	....	10.00	....	....	3.00	....
8	8.76	4.38	11.31	12.96	58.39	4.20	70.00
.	....	....	10.00	....	....	4.00	....
9	8.92	4.98	13.25	13.77	55.29	3.79	70.00
.	....	....	12.00	....	....	3.00	....
8	8 47	3.93	10.69	12.06	60.36	4.49	65.00
.	....	....	7.00	....	....	3.00	....
5	9.43	3.10	11.88	9.35	61.96	4.28	66.00
.	....	....	10.00	....	....	3.00	....
5	9.00	3.50	12.56	8.55	61.16	5.23	63.00
.	....	....	9.00	....	....	4.00	....
5	8.05	5.05	12.94	9.91	60.87	3.18	58.00
.	....	....	13.00	....	....	2.00	....
7	8.72	4.98	11.88	10.88	59.80	3.74	65.00
.	....	....	10.00	....	....	4.00	....
1	7.84	5.90	11.38	10.15	61.74	2.99	64.00
.	....	....	10.00	....	....	3.25	....
)	8.43	4.18	9.38	12.82	60.04	5.15	63.00
.	....	....	8.00	....	....	3.00	....
)	8.14	4.18	10.25	12.93	61.02	3.48	66.00
.	....	....	9.00	....	....	3.00	....
2	10.68	3.20	9.81	8.14	63.77	4.40	66.00
.	....	....	8.00	10.00	70.00	5.00	....
)	8.60	5.05	14.00	12.05	56.12	4.18	63 00
.	....	....	10.00	....	....	3.00	....
3	11.38	2.40	11.00	5.87	64.92	4.43	66.00
.	....	....	....	....	....	....	....
2	8.13	8.25	20.88	11.21	47.14	4.39	58.00
.	....	....	16.50	....	....	3.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Continued.* *Horse, Dairy and Stock Feeds—Continued.*	
13927	Niagara Dairy Feed. Boston Feed Store, Willimantic	Willimantic: Boston F Store
		Guaranty
13741	Bufceco Dairy Feed. Buffalo Cereal Co., Buffalo, N. Y.	Shelton: Ansonia Flour Grain Co.
		Guaranty
13800	Lactola Dairy Feed. Chapin & Co., Hammond, Ind.	Somers: W. C. Everett
		Guaranty
13799	Triangle Dairy Feed. Chapin & Co., Hammond, Ind	Somers: W. C. Everett
		Guaranty
13801	Unicorn Dairy Ration. Chapin & Co., Hammond, Ind.	Somers: W. C. Everett
		Guaranty
13925	Crosby's 1918 Dairy Ration. E. Crosby Co., Brattleboro, Vt.	Willimantic: Boston F Store
		Guaranty
13767	Eshelman's 20 Dairy Feed. John W. Eshelman & Sons, Lancaster, Pa.	Torrington: D. L. Talcot
		Guaranty
13887	Globe Creamery Feed. Globe Elevator Co., Buffalo, N. Y.	New Milford: Geo. E. Ac Co.
		Guaranty
13792	Twin Six Dairy Feed. D. H. Grandin Mill. Co., Jamestown, N. Y.	Granby: E. H. Rollins
		Guaranty
13917	Twin Six Dairy Feed. D. H. Grandin Mill. Co., Jamestown, N. Y.	Norwich: Norwich Grain
		Guaranty
13749	H. O. Algrane Milk Feed. H. O. Co.'s Mills, Buffalo, N. Y.	Ansonia: Ansonia Flou Grain Co.
		Guaranty
13813	Read the Tag Dairy Feed. H. O. Co.'s Mills, Buffalo, N. Y.	Bristol: Goodsell Bros.
		Guaranty
13757	Gold Flake Dairy Feed. Hales & Edwards Co., Chicago, Ill.	Thomaston: Thomaston (& Grain Co.
		Guaranty
13922	Haven's Special Dairy Feed. Havens & Son, Jewett City	Jewett City: Havens &
		Guaranty
13862	Morgan's Balanced Ration. Hubbell Coal & Storage Co., Saugatuck	Saugatuck: Hubbell Coa Storage Co.
		Guaranty
13863	Morgan's Balanced Ration. Hubbell Coal & Storage Co., Saugatuck	Saugatuck: Hubbell Coa Storage Co.
		Guaranty
13798	Larro-Feed. Larrowe Milling Co., Detroit, Mich.	Suffield: Spencer Bros.
		Guaranty
13830	Barford's Balanced Dairy Ration, Meech & Stoddard, Inc., Middletown	Hartford: Meech Grain C
		Guaranty
13899	Barford's Balanced Dairy Ration. Meech & Stoddard, Inc., Middletown	Middletown: Meech & S dard, Inc.
		Guaranty

INSPECTION OF 1919—*Continued.*

Station No.	Pounds per Hundred.						P… p… t…
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13927	7.89	5.15	17.50	15.90	49.46	4.10	$70.00
....	....	....	....	....	....	....	....
13741	8.08	4.50	13.06	11.01	58.93	4.42	68.00
....	....	....	12.00	12.00	....	3.00	....
13800	8.18	5.19	17.88	11.37	52.76	4.62	64.00
....	....	....	16.50	....	....	3.00	....
13799	8.17	6.33	21.00	9.20	60.35	4.95	78.00
....	....	....	21.00	....	....	4.00	....
13801	7.38	5.98	26.19	11.02	43.55	5.88	82.00
....	....	....	26.00	....	....	4.00	....
13925	7.10	4.63	25.44	14.43	40.61	7.79	75.00
....	....	....	25.00	15.00	59.00	6.00	....
13767	9.21	7.86	21.25	13.27	42.87	5.60	66.00
....	....	....	20.00	....	....	4.00	....
3887	8.77	4.90	27.13	11.08	42.77	5.35	74.00
....	....	....	23.00	....	....	5.00	....
3792	8.06	5.75	24.13	11.33	46.40	5.33	76.00
....	....	....	22.00	....	....	5.00	....
917	8.05	5.90	24.81	11.09	44.69	5.46	76.00
...	....	....	22.00	....	....	5.00	....
749	8.27	5.38	14.63	10.48	57.73	3.51	64.00
...	....	....	14.00	15.00	....	4.00	....
13	8.16	5.50	22.38	8.93	50.54	4.49	68.00
..	....	....	20.00	9.50	....	5.00	....
57	9.20	6.84	14.50	17.20	49.26	3.00	60.00
.	....	....	16.00	....	....	3.50	....
2	9.93	4.75	22.75	9.36	48.46	4.75	65.00
.	....	....	18.00	....	....	4.00	....
2	7.88	5.18	19.56	11.30	46.38	9.70	62.00
	....	....	18.00	....	....	8.00	....
	7.73	5.90	22.44	11.45	44.40	8.08	68.00
	....	....	22.00	....	....	8.00	....
	8.61	5.58	21.56	11.09	48.82	4.34	78.00
	....	....	20.00	....	....	3.00	....
	8.61	5.10	21.31	10.31	49.88	4.79	80.00
	....	....	19.00	....	....	5.50	....
	9.60	5.18	21.25	10.91	47.78	5.28	77.00
	....	....	19.00	....	....	5.50	..

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	PROPRIETARY MIXED FEEDS—*Concluded.* *Horse, Dairy and Stock Feeds—Concluded.*	
13900	Barford's Balanced Dairy Ration. Meech & Stoddard, Inc., Middletown	Middletown: Meech & Sto dard, Inc. .... Guaranty ....
13897	M. & S. Dairy Feed. Meech & Stoddard, Inc., Middletown	Middletown: Meech & Sto dard, Inc. .... Guaranty ....
13753	Stevens' 44 Dairy Ration. Park & Pollard, Boston, Mass.	Waterbury: Spencer Gra Co. .... Guaranty ....
13868	Purina Cow Chow Feed. Purina Mills, St. Louis, Mo.	Norwalk: C. E. Slauson C Guaranty ....
13869	Protena Dairy Feed. Purina Mills, St. Louis, Mo.	Norwalk: C. E. Slauson C Guaranty ....
13760	Big Q. Dairy Ration. Quaker Oats Co., Chicago, Ill.	Litchfield: The Wadham Co. .... Guaranty ....
13808	Vitality Dairy Feed. Rosenbaum Bros., Chicago, Ill.	Plainville: Eaton Bros. .... Guaranty ....
13921	Will-Pay Dairy Feed. Rosenbaum Bros., Chicago, Ill.	Jewett City: Havens & Sc Guaranty ....
13884	True Value Dairy Feed. Stratton Ladish Milling Co., Milwaukee, Wis.	New Milford: Geo. T. Sou Guaranty ....
13780	Syragold Dairy Feed. Syracuse Milling Co., Syracuse, N. Y.	Norfolk: August Curtiss .. Guaranty ....
13789	Syragold Milk Ration. Syracuse Milling Co., Syracuse, N. Y.	Simsbury: Woods-Chandl Co. .... Guaranty ....
13821	Ti-O-Ga Red Brand Dairy Feed. Tioga Mill. & Elev. Co., Waverly, N. Y.	West Cheshire: G. W. Thor Guaranty ....
13781	Biles Ready Dairy Ration. Ubiko Milling Co., Cincinnati, Ohio	Canaän: Ives & Pierce .... Guaranty ....
	POULTRY FEEDS.	
13851	Bufceco Poultry Mash. Buffalo Cereal Co., Buffalo, N. Y.	Meriden: Meriden Grain Feed Co. .... Guaranty ....
13766	Laying Mash. John W. Eshelman & Sons, Lancaster, Pa.	Torrington: D. L. Talcott . Guaranty ....
13881	Buffalo Laying Mash. Globe Elevator Co., Buffalo, N. Y.	Brookfield: C. R. Dubia ... Guaranty ....
13786	Red Comb Mash Feed (with dried buttermilk). Hales & Edwards Co., Chicago, Ill.	New Hartford: Case Schwab .... Guaranty ....
13814	*H. O. Co.'s Laying Mash. H. O. Co.'s Mills,* Buffalo, N. Y.	*Bristol: Goodsell Bros.* .... Guaranty ....

INSPECTION OF 1919—*Continued.*

ition No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N. x 6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
900	8.67	5.20	22.00	11.93	46.81	5.39	$77.00
...	....	....	19.00	....	....	5.50	....
897	9.68	3.90	20.81	9.05	51.07	5.49	76.00
...	....	....	18.00	....	....	4.00	....
753	7.75	5.94	24.50	11.87	43.39	6.55	78.00
...	....	....	24.00	....	....	5.00	....
868	9.55	6.25	24.25	12.42	43.22	4.31	85.00
...	....	....	24.00	12.00	....	4.80	....
869	8.35	7.10	18.00	13.59	49.43	3.53	70 00
...	....	....	16.50	....	....	3.50	....
760	9.00	5.93	21.13	10.33	48.83	4.78	78.00
...	....	....	21.00	11.00	50.00	5.00	....
808	8.78	4.16	22.13	9.60	49.28	5.05	80.00
...	....	....	20.00	....	....	4.00	....
921	10.34	7.19	18.50	9.87	50.61	3.49	64.00
...	....	....	16.00	....	....	3.50	....
884	8.55	6.59	24.63	9.64	44.50	6.09	80.00
...	....	....	24.00	....	....	5.00	....
780	9.77	3.95	18.81	7.34	55.54	4.59	78.00
...	....	....	18.00	....	....	5.00	....
789	8.35	5.60	23.13	15.66	42.63	4.63	70.00
...	....	....	20.00	....	....	4.50	....
821	8.69	6.50	26.63	9.35	42.84	5.99	76.00
...	....	....	23.50	....	....	3.50	....
781	8.95	5.68	23.50	9.57	47.31	4.99	81.00
...	....	....	24.00	10.00	50.00	5.00	....
851	8.97	3.83	16.69	4.88	60.65	4.98	81.00
...	....	....	15.00	5.00	....	4.00	....
766	9.71	7.78	22.06	5.38	49.10	5.97	78.00
...	....	....	20.00	....	....	5.00	....
881	10.11	8.25	22.13	8.88	46.21	4.42	78.00
...	....	....	20.00	....	....	8.00	....
786	9.95	12.45	16.50	6.86	50.66	3.58	80.00
...	....	....	15.00	....	....	4.00	....
814	8.01	9.83	20.44	5.32	51.14	5.26	78.00
...	....	....	17.00	6.00	....	4.50	....

TABLE VI.—ANALYSES OF COMMERCIAL FEEDS,

Station No.	Manufacturer and Brand.	Retail Dealer.
	POULTRY FEEDS—*Concluded.*	
13901	M. & S. Dry Mash. Meech & Stoddard, Inc., Middletown	Middletown: Meech & Stoddard, Inc.
		Guaranty
13818	Lay or Bust Poultry Mash. Park & Pollard Co., Boston, Mass.	Plantsville: C. A. Cowles
		Guaranty
13784	Park & Pollard Growing Feed. Park & Pollard Co., Boston, Mass.	Canaan: Ives & Pierce
		Guaranty
13922	Purina Chicken Chowder. Purina Mills, St. Louis, Mo.	New Haven: Crittenden-Benham Co.
		Guaranty
13847	Ful-O-Pep Dry Mash. Quaker Oats Co., Chicago, Ill.	Rockville: Rockville Milling Co.
		Guaranty
13810	Vitality Egg Mash (with milk albumen). Rosenbaum Bros., Chicago, Ill.	Plainville: Eaton Bros.
		Guaranty
13928	Chic Chuck. Russia Cement Co., Gloucester, Mass.	Rockville: Rockville Milling Co.
		Guaranty
13853	Wirthmore Mash Feed. C. M. Cox Co., Boston, Mass.	Meriden: Meriden Grain & Feed Co.
		Guaranty
13866	Ti-O-Ga Growing Mash. Tioga Mill. & Elev. Co., Waverly, N. Y.	Norwalk: C. E. Slauson Co.
		Guaranty

INSPECTION OF 1919—*Concluded.*

Station No.	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N.x6.25)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Crude Fat)	
13901	9.32	7.88	21.75	6.26	49.42	5.37	$76.00
....	....	....	12.00	....	....	3.00	....
13818	8.13	11.98	21.56	8.16	46.79	3.38	82.00
....	....	....	18.00	....	....	1.50	....
13784	9.84	7.92	16.31	4.70	55.59	4.64	84.00
....	....	....	10.00	....	....	1.50	....
13932	9.38	7.68	20.38	8.76	49.24	4.56	90.00
....	....	....	19.00	....	....	4.00	....
13847	8.47	9.73	22.25	8.40	45.07	6.08	84.00
....	....	....	20.00	....	....	4.00	....
13810	8.06	13.48	18.69	8.35	46.99	4.43	80.00
....	....	....	18.00	....	....	4.00	....
13928	6.04	35.78	55.50	....	0.43	2.25	95.00
....	....	....	50.00	....	....	2.00	....
13853	8.96	9.00	22.31	6.58	48.11	5.04	81.00
....	....	....	20.00	....	....	4.00	....
13866	8.60	1.61	15.69	5.10	65.04	3.96	85.00
....	....	....	12.00	6.00	....	2.00	....

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

Bulletin 222 August, 1920

NEW OR UNUSUAL

PLANT INJURIES AND DISEASES

Found in Connecticut, 1916-1919

By

GEORGE P. CLINTON, Sc.D., Botanist

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The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the editions permit.

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August, 1920.

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REPORT OF THE BOTANIST,

G. P. CLINTON,

FOR 1919.

NEW OR UNUSUAL PLANT INJURIES AND DISEASES, FOUND IN CONNECTICUT, 1916-1919.

INTRODUCTION.

In our first Report, for 1903, we gave brief mention of all of the Connecticut plant troubles, not including insect injuries, that had been reported by others or observed by ourselves up to that time. Since then in most of our Reports, additional troubles have been recorded in the same manner. However since 1915, no account, in this general way, has been rendered of the troubles that have come to hand during these four years. It is the aim of the present Report to cover this period, reporting such of these as have been definitely determined.

As in previous Reports we discuss both diseases and injuries, including abnormal or monstrous growths, of all our economic plants. Most of these troubles are caused by fungi and they are indicated here by the common name in small caps with the scientific name, where definitely known, in italics. The other *troubles follow these and are indicated by a common name* printed in italics. As practically all of these latter are mechanical, environmental or so-called physiological diseases or injuries, they have no scientific name. As in the past these troubles are most conveniently reported in alphabetical order under their hosts, also arranged alphabetically according to their common names with scientific names following.

We shall not attempt here to give in any detail, as previously, the weather conditions of each year and their bearing on the suppression or development of these troubles. It might be well to note in passing that the winter of 1917-1918 was one of the most severe winters since we began our disease survey of Connecticut, and that there resulted great injury to perennial plants, especially to cultivated fruit trees. The injury to the wood and flower buds of peach trees from this and the preceding and

following winters has been such as to put this prominent fruit industry largely out of business. The spring and early summer of 1918 were so wet and the midsummer so dry that very unusual troubles of potatoes, largely physiological, developed. Furthermore the spring and summer of 1919 had so much rainy or muggy weather that an unusually large number of fungous diseases developed, including very serious injury by the late potato blight. The lack of potash in most fertilizers, due to the war during these years, also played some part in the development of unusual troubles, especially of potato and tobacco.

Before proceeding to a specific account of these various troubles, we wish to briefly discuss here two that do not come strictly under the designation of "plant diseases," since while of a fungous nature their injurious activities were directed to the destruction of household timbers in one case, and household butter in the other.

DRY ROT.

DRY ROT FUNGUS, *Merulius lacrymans* (Wulf.) Schum. We first called attention to this fungus in our Report of 1906, pp. 336-41, where we noted, with illustrations, its action on the wainscoting of a church basement at Stony Creek. Again, in 1916 (Rep. **1915**: 424-5.) we reported a vigorous development of the fungus on flooring, boxes, tools and heads of sewing machines at the Singer Mfg. Company's Plant in Bridgeport.

An even more destructive and luxuriant growth of the fungus, than at either of these places, was called to our attention in July, 1918, by Mrs. Robert H. Comstock, who wrote in part as follows: "Five years ago we built a small house on high farm land along the sandy beach of the Sound at Westbrook, Conn. We laid a cement foundation but did not dig a cellar and when the land was graded the cement was almost entirely covered, as we particularly wanted the cottage to set low. For several years we have noticed a fungous growth on the partitions and under some built-in drawers in the middle of the house. This spring we found the floor was rotted out, even the top floor was more than half gone." Plate XXXIII, a.

At Mrs. Comstock's request we inspected this unoccupied shore cottage, a view of which is given here, making a detailed examination as to the cause and the amount of injury. It was readily seen that the trouble was due to the dry-rot fungus, *Merulius lacrymans,* as it was found in good fruiting condition. In fact the spores from the fruiting bodies had developed so abundantly that they had settled as a very evident reddish-brown dust all over the floors and tables except where these were protected by covers so that when the latter were raised a distinct boundary showed between the covered and uncovered surfaces. The cement foundation had practically no openings allowing for ventilation, thus there was a closed air space of about a foot between the wood beams supporting the double floor and the ground. This prevented the drying-out of the air and gave ideal conditions for the development of the fungus when once it got started on the wood. There were no eave troughs to carry away the water from the roof and likewise the water from the ice-box went into the ground under the house, thus increasing the dampness.

Some idea of the destruction of the woodwork can be gained from the two pictures shown here, one with the flooring partially removed. Some of the wood was so rotten as to crumble easily as punk between the fingers. The entire floor of the living room, Plate XXXIII, b, together with the floor joist, had to be removed. Considerable injury in the kitchen, Plate XXXIII, c, under a built-in set of drawers and in an adjacent closet also was evident, and here the fungus had gone up between the walls of the board partitions a short distance. There was no evidence that the fungus had reached the second story. The fungous growth was very luxuriant on the under surface of the floor boards both in its thick, whitish, felt-like mycelium and, in places, in the reddish-brown, laxly-poroid, fruiting surfaces.

The remedial measures suggested were as follows:—The removal and burning of all infected wood and rubbish; the creosoting, if possible, of the new wood used; the building of several sunken areaways, protected only by wire netting, to allow free access of air under the house; the placing of eaves and leaders and a drain to carry away the water from the roof and the ice chest. A year later we examined the cottage and found that

most of these suggestions had been carried out. There was a very good air drainage under the house by five sunken openings, two on one side and three on the other, and part of the earth had been removed making a larger air space. We saw no indications of further development of the fungus. Somewhat similar suggestions were made for the Stony Creek and Bridgeport outbreaks. We have had no complaints of further trouble at either of these places, and so judge that the fungus has been kept largely if not entirely in check. We are convinced from our experience that this fungus depends in great measure for its development upon a fairly small and tightly closed air space next the wood, and a sufficient amount of water to keep the air therein constantly saturated or at least above the normal amount.

MOLDY UNSALTED BUTTER.

The second trouble, see Plate XXXIV, a, that of moldy unsalted butter, was really first called to our attention in 1913. With Mr. Stoddard we made a preliminary investigation of the trouble then and during 1914 and 1915, intending to make a more complete study of it later, but as no complaints have come in since we have not done so. We make this short report here as a matter of record as little has been published by botanists in this country about the trouble.

The first sample sent us was received in the late fall of 1913 from A. L. Kuran of the New Hartford Creamery. In January, 1914, Prof. H. F. Judkins of Storrs sent us a pound package from the Suffield Creamery and another sample from a different source in November. In these and most other samples seen of wrapped butter, there developed on the surface more or less numerous small spots of a blackish and others of a decided reddish color. These were easily determined as due to fungous growths. In all the samples seen these molds did not penetrate very deeply into the butter. One of the specimens which we have kept ever since 1915 in a closed glass jar, now, however, shows the whole surface overgrown with mixed olive-black and reddish growths and the interior entirely changed into a somewhat dried red substance penetrated by mycelium. Concerning the Suffield sample Prof. Judkins, under date of Jan. 7th, wrote in part as follows:

"I am sending in a separate package a pound of butter which I obtained from the Suffield creamery. You will note that this butter is unsalted and it is a rather long story to tell all the troubles Mr. Totman, the butter-maker, has had with his butter since last spring, so I will not recite them to you now.*

"I am very much interested to find out what kind of growth or growths there is on this butter, particularly the red growth. He has never noticed any of this growth on salted butter. He has never noticed any of the growth as long as it stayed in his refrigerator.

"The print which I am sending you was one of a lot, made on November 25th, sent to New Haven and returned to the creamery on December 6th, in practically the same condition that it is in now, showing that the cold evidently checked the growth of the mold.

"In making a careful examination of the prints and molds used by the buttermaker, I ran across four or five cakes of cottage cheese on one of the shelves in the refrigerator, one of which I am sending you along with the butter. This was made over a year ago and has gone so bad that the mold even penetrated the parchment paper in which it was wrapped. I have, of course, ordered that cleaned up and the place thoroughly disinfected.

"I am wondering whether there is any connection between this and the growth in the butter. On the other hand, if we can trace back the growth in the butter to perhaps one or two of the creamery patrons, I may be able to find the cause of the butter going rancid so rapidly. I am anxious to see the trouble straightened out, if possible, because the creamery will not long exist if the trouble continues to break out at frequent intervals."

In February, 1915, we sent a form letter to all of the creameries of the state asking for information concerning this trouble. The replies received showed that many were unacquainted with it, partly because they did not make unsalted butter, but four or five reported more or less trouble of this kind. Later in the year Mr. Stoddard made an examination of two or three creameries to determine, if possible, conditions favoring its development. Separation cultures were made by Mr. Stoddard from several of the samples received at different times, and the following fungi were obtained:

(1) *Mucor,* sp. undet. (2) *Alternaria,* sp. undet. (3) *Penicillium roqueforti,* according to Thom. (4) *Oidium lactis,* a common fungus of milk and its products. (5) *Epicoccum,* probably *E. purpurascens.* The *Epicoccum* at first was mixed with the *Oidium* in our cultures and did not form spores. We thought it might be an *Oidium* or *Oospora.* Later Mr. Stoddard got it in pure cultures producing the characteristic spores of several cells united into a globular, semi-sessile ball. This last fungus is the one that was responsible for the red colonies in the butter. The *Penicillium* was responsible for blue-green and the *Alternaria* and *Mucor* for blackish growths.

Some inoculations on good unsalted butter were tried but were not very successful, in most cases developing best when the fungus worked down between the tubes and the butter where there was little air space and more moisture. There seemed to be some indication, too, that certain species followed in the wake of the others. However our tests were not extensive enough to be very trustworthy. If the inoculations had been made on butter covered with paper better results might have been obtained.

Concerning the development of the trouble in the creameries, etc., the following information was obtained. The molds were confined to unsalted butter, the salt evidently acting as a preservative. Some claimed that where the butter was wrapped in paper dipped in hot brine they were not so likely to develop. Others claimed that when the milk was pasteurized there was no trouble. Undoubtedly in some cases the trouble was due to unsanitary conditions in the dairy itself, as in the case cited by Prof. Judkins. Care in handling the butter after it was made, especially as regards moisture, cold storage and length of time the butter was kept, also entered into the problem.

Another quite important factor was the condition of the milk when it arrived at the creamery. Most of the fungi isolated were common saprophytic species that easily develop in cattle barns on moist hay, bedding, silage, etc. Petrie dish exposures by Mr. Stoddard in two barns developed very similar species to those recorded here. The *Epicoccum* was thus obtained both in barns and in one of the creameries where this trouble developed. The cleanliness of the barn, the care used in milking and keeping the air free from dust at that time and the protection given the milk before delivery, all are factors determining the number of spores that will fall into the milk and cause trouble later.

While unsalted butter is still used to a considerable extent by Jewish families and some of the larger hotels and restaurants, the reason no complaints have been made in recent years is probably because most of the creameries of the state have gone out of business. Their decline was due to their inability to compete with milk sold for direct family use and to the destructive competition of the large milk corporations that now dominate

There are comparatively few references, so far as we have found in botanical literature, concerning molds that cause trouble in butter. We are indebted to F. C. Stewart for calling our attention to several of the following:

European investigators have done the most work along this line. Lafar and his co-editors (Handb. Techn. Myk. 1907 ed.) give resumés of most of this work together with references to the literature. In vol. 2, p. 214, *Cladosporium butyri*, a fat-splitting fungus, is mentioned, especially in connection with *Oidium lactis*, as a cause of rancid butter; while, pp. 220-1, bacteria are mentioned as causing red and blue specks in butter, nothing is said about fungi causing similar color troubles. In vol. 4, p. 525, *Mucor Mucedo* and *M. racemosus* are also mentioned as fat-splitting fungi found in butter.

Gripenberg (Milch. Zeitung **28**: 626-8, 644-6, 662-3. 1899.) published quite an extensive article dealing with experiments under which infection of butter takes place. He found infection comes from the wood of the tubs, the paper wrappings and the air. The chief fungi responsible are *Mucor, Penicillium,* and *Trichosporium.* Hard wood tubs, thick paper, absolute cleanliness, soaking tubs and paper in concentrated salt solutions (over 25%) or steaming paper and tubs are preventive measures recommended.

According to Stewart, Happich (Zeitschr. Fleisch- Milch-hygiene *11*: 297.) found *Botrytis, Oidium lactis, Penicillium* and *Mucor* in moldy butter. Hanus and Stocky (Zeitschr. Unters. Nahr. Genussm. **3**: 606. 1900.) report *Mucor Mucedo* to be a fat-splitting agent in butter.

We found no definite references in European literature to red spots in butter caused by a fungus, though according to Saccardo, (Syll. Fung. **4**: 20. 1886.), Trabut reports *Oospora ruberrima,* originally described by Saccardo on damp wax of wasps, as occurring on butter in Algiers. The spore masses of this fungus are red.

In America, while considerable work has been published on the bacteria of milk and its products, but little along the same line has made its appearance concerning fungi, except that on cheese by Thom and others. However we have found a few references to moldy butter, chiefly relating to control methods

Apparently not so much trouble is experienced now as formerly because of this advanced knowledge of control methods.

Duggar (N. Y. Prod. Rev. Amer. Creamery. Oct. 27, 1897.) in a popular article was one of the first, at least among botanists, to suggest preventive measures for controlling molds of tub and paper-wrapped butter. He found tubs made of sap wood most objectionable, spreading from this through the paper into the butter. He advised steaming the tubs and keeping them dry; also treatment of paper and tubs with copper sulphate.

Rogers (Exp. Sta. Rec. 14: 534. 1903.) is reported as isolating a fat-splitting torula yeast from several samples of canned butter. Its action was weaker than that of fat-splitting molds. The same author (U. S. Dep. Agr. Bur. Anim. Ind. Bull. 89: 7-13. 1906. *Ibid.* Circ. 130: 1908.) described methods of "Preventing Molds in Butter Tubs" and "Paraffining Butter Tubs" in the publications here cited and especially recommended the paraffining of tubs giving directions and details.

About the only article dealing with the fungi causing these troubles is that by Thom and Shaw (Journ. Agr. Res. 3: 301-10. 1915.) on "Moldiness in Butter." They classify the fungi found under the following headings: (1) Smudged or *Alternaria* type, including here besides the *Alternaria, Cladosporium butyri, Stemphylium butyri* Patt., *Cladosporium* sp., and our red fungus, an undetermined specimen of which was sent them. (2) Green-mold type, including *Penicillium roqueforti, P. expansum, P. chrysogenum,* etc. (3) Oidium type, producing various shades of orange-yellow by *O. lactis.* Besides these fungi they noted under certain conditions the presence of *Mucor* sps.

INJURIES AND DISEASES OF PLANTS ARRANGED ACCORDING TO HOSTS.

Apple, *Pyrus Malus.*

Bacterial Fruit Spot, Bacteria undet. Plate XXXIV, b. Early in October, 1919, several diseased apples were received for examination from Mr. E. M. Ives of Meriden. Two of these presented an appearance, in certain areas, a little different from anything that we had seen before; in fact, on superficial examination, these areas looked as if they might be due to spray or sun scorch of an unusual type. An examination of the injured tissue, however, revealed the presence of such numbers of

bacteria as to lead us to the conclusion that these were, if not the primary, at least the secondary cause of the trouble. The skin over these extended irregular areas was slightly sunken and reddish-brown in color, in strong contrast with the normal reddish skin. The parenchyma cells immediately beneath the diseased areas were also reddish-brown, as compared to the normal white tissue, and were somewhat collapsed with contents dead. The bacteria were especially abundant in the intercellular spaces. While the apple showed injury by the railroad worms, these had no apparent relation to the bacteria since their channels were not connected with this injury. The photograph reproduced here gives a somewhat unsatisfactory view of the trouble because of the high lights shown, but the principal diseased area is in the center from which a strip of the skin has been removed.

Cultures were attempted by taking tissue from the interior diseased parenchyma and placing it in test tubes of agar. Practically all of these produced bacteria but they were not pure, showing in some cases yellowish and in others whitish growths in the different tubes. The latter seemed the most likely to contain the injurious species but cultures made directly from these colonies, without attempts to isolate a single form, also showed that they were impure. Further work at this time being neglected, the cultures were left until too late to properly isolate and identify the organism. While these bacteria might have been an accidental invasion following some previous injury, it is also possible they were the pear blight organism on an unusual part of the host, since this organism occurred in these orchards especially on pears, and the owner kept bees. However, we have seen no references in literature where this blight occurred on mature fruit after the manner described here.

BARK CANKER, *Myxosporium corticolum* Edg. This fungus while not reported before is evidently not a new or uncommon one in this state. It does not seem to be a very vigorous parasite as it is often associated with winter injury of the bark or wood. When so associated it looks much like the black rot canker, *Sphaeropsis malorum*, with which it is often confused, especially as the two are sometimes found in the same collection or even together on the same branch. The bark canker seems to penetrate less deeply, being confined to the bark which may

slough off and a new growth free of the fungus develop beneath. The fruiting pustules of the two are also similar, but, if the spores are oozing out, the white tendrils of the bark canker usually distinguish it from the black rot canker whose spores are deeply colored. However, when young the black rot spores are also hyaline and about the same size (perhaps average wider) and shape, so they may be mistaken for each other. In fact on the winter injured specimens mentioned in our Report for 1906, p. 310, both these fungi are present according to our recent examinations, although originally we reported only the black rot. The bark canker was called especially to our attention in the spring of 1919 by specimens from Danbury, which contained both this and to a less extent the black rot fungus; it was also found a short time later prominent on a small winter injured tree at East Haven.

Paddock (N. Y. Agr. Exp. Sta. Bull. 163: 203. 1899. *Ibid.* 185: 211. 1900.) and Stewart *et al.* (*Ibid.* 191: 298. 1900.) were the first to make early mention of this fungus which they called *Macrophoma malorum.* More recently Edgerton (Ann. Mycol. **6**: 48. 1908.) has shown that this name is a synonym of the black rot fungus and he has described the bark canker as a new species and given it the scientific name used here. Paddock's inoculation experiments with the fungus failed to show its parasitic nature; so it is not likely to prove a serious pest at best.

Downy Mildew Rot, *Phytophthora cactorum* (Cohn & Leb.) Schroet. In late August, 1918, the writer received a dozen dried apples from J. S. Adam of Canaan, Conn., which had been stored in paper bags since the previous fall. These apparently had not rotted but dried down into the preserved specimens much like raisins. They were so full of sugar that Mr. Adam wanted to know if this was an unusual occurrence. Upon examining the reddish preserved tissues microscopically, we were much surprised to find an abundance of a non-septate guttulate mycelium, of variable diameter, much like that of *Phytophthora.* Cultures attempted from this tissue failed, however, to produce any growth so the mycelium was evidently dead at this time. The next year stored pears sent from Bridgeport showed the same type of non-fruiting mycelium present; in this case we were able

to isolate the fungus, produce its fruiting stage in cultures, and so accurately establish its identity as above named. A more complete statement concerning the fungus is given in this paper under Pear, *q. v.*

HEART ROTS, *Polyporus admirabilis* Pk. and *P.* (*Spongipellis*) *galactinus* Berk. Dodge (Myc. **8**: 5-14. Ja. 1916.) in his article entitled "Fungi Producing Heart-Rot of Apple Trees" describes these two species as partly responsible for this trouble. The former occurs singly, or more frequently in calla-lily-like clusters, on the trunks showing as large milk-white, centrally depressed, fragile, fleshy fungi that on drying become hard and leathery and have a peculiar "glacé kid glove" feel to the upper surface. His observations on the species were made chiefly in Litchfield Co., Conn. He collected specimens at the Columbia Camp and vicinity near Litchfield, but he reports other specimens from Redding. In May, 1918, the writer also collected an old specimen of this species on a dead apple tree at Union, Conn.

The second species, *P. galactinus*, is smaller but in its bracketed group becomes even more conspicuous and is of about the same color. Dodge reports this from the same two localities as the other species. Recently Murrill (Myc. **11**: 310. 1919.) also noticed it on apple trees in Eastern Connecticut, and the writer collected it on a living apple tree at Norfolk in 1916. Others have also reported it from Connecticut. Both of these fungi, while causing a rot of the heart wood, do not seem to especially attack the living tissue and so cause much less damage than if that were the case.

WHITE HEART ROT, *Fomes igniarius* (L.) Gill. We have seen this fungus several times in this state upon living apple trees. The oldest specimen we have in the herbarium is from Norfolk, collected in September, 1913, and it was found there again in 1916. It was also collected twice from an apple tree at Milford, the latter year. It is treated more fully under Oak, *q. v.*

Hail Injury. In one of our spray bulletins, which see (Conn. Agr. Exp. Sta. Rep. **1911**: 382. 1912.), we briefly mentioned and showed a half tone of hail injury to the apples at our Mt. Carmel farm. Hail storms coming on the young fruit produce in time some misshapening of the mature fruit but

especially show their effect as conspicuous russeted or corky spots on the skin. In 1918 we heard of more or less injury at Wallingford to the fruit but had particularly called to our attention hail injury to the twigs in the Bellinger orchard at Litchfield. Mr. Stoddard, who examined the orchard to obtain data, found that it appeared on the 1 to 3 year old twigs on a certain side of the trees and the owner recalled a severe hail storm of the previous year that came from that direction. The beating of the hail had so bruised the bark that a callous growth was formed beneath, causing the bark to split open and reveal the slight swelling.

Malformed Twigs and AERIAL CROWN GALL, *Pseudomonas tumefaciens* (Sm. & Town.) Stev. Plates XXXV, a-b. Besides the hail injury mentioned above, we have received at various times for identification peculiar malformations of apple twigs, as to the cause of which we were not always sure. Two of these are shown in the illustrations given here. The one that is shown in Fig. a, we have usually called aerial crown gall. The ordinary nursery type of galls at the base of stems and the hairy root, we have mentioned in our Report for 1903, but the specimens considered here have been studied without a chance to examine the trees in the orchard and thereby determine the condition of their roots. These aerial galls occur on both young and old trees. Hedgecock (U. S. Bur. Pl. Ind. Bull. 186: 15. 1910.) pictures (Plate V, Fig. 1) and describes this form and associates it with the hairy root type of crown gall. Garman (Ky. Agr. Exp. Sta. Bull. 93: 106. 1901.) previously pictured and described a similar trouble as a "Knot Disease," and while he thought it contagious he did not associate it with the crown gall which he described in the same bulletin.

This trouble is usually found by the apple growers in late winter when pruning the trees and the specimens sent us show as a distinct lateral growth on the branch or as a swelling at the base of a side branch. Occasionally it takes the form of a distinct spherical knob like the typical basal crown gall. More frequently it forms flattened growths, at first perhaps smooth or with smaller knobs on it but usually with an abundance of small closely packed protuberances something like adventitious buds. These affected tissues die prematurely so that we have

never seen these "buds" develop further. Some of these areas on larger branches reach a lateral diameter of two inches, or where abundant, individuals may partly coalesce into even larger areas, but they rarely grow out half an inch beyond the surface of the bark. While we have never heard of these growths killing the whole tree, where extending completely around the branches as they sometimes do, they killed these in time.

The specimens preserved in the Station's herbarium and letters show data as follows: (1) W. T. Coe & Son, Durham, Apr., 1907, branches ½ to 1½ inches diameter, in center of tree, with numerous irregular swellings with abundance of "buds" on these. (2) J. O. Landon, Norwich, Mar., 1911, rounded smooth typical gall on ¾ inch branch showing winter injury of heart wood. Reported several galls on a single 12-15 year old tree. (3) E. S. Lovell, Newton, Apr., 1913, several irregular and roughened swellings, largest about 1 inch diameter, around twigs about half their size. Three Sour Bough trees infected. (4) F. P. Tolles, Terryville, Apr., 1915, branches 2 inches diameter with large flattened areas with abundance of "buds." (5) C. E. Shepard, Mt. Carmel, Apr., 1917, branches on young tree, shown in photograph. (6) H. J. Tillson, County Agent, found in orchard near Norwich, Mar., 1917, same type as Lovell specimens; one tree badly infected.

The other type of abnormal growth has been sent less frequently for identification, and we are even less certain of its origin. The specimens, illustrated in Fig. f, were received in March, 1913, from J. T. Cullen, Derby. These show young twigs with an evident swelling below a terminal bud or branch that has been killed and a new branch developed from a lateral bud. The swelling is largely due to an abnormal development of spongy parenchyma which at least in some cases dies prematurely. One could easily imagine such a growth due to winter injury of the terminal branch or bud, to insect stings or mechanical injury in some way. Quite frequently one sees in orchards, especially on certain varieties, as Ben Davis, very similar natural swellings apparently due to abundance of food material stored in the tip of the year's growth that retains the swelling somewhat the next year at the base of that year's growth. No injury to the tissues follows in these cases. There are

cases where such malformations as described here are claimed to be the result of the crown gall bacteria. Hedgecock (*loc. cit.*, Plate IV, figs. 1-2) shows by his illustrations and his statement that they are the "early stage of the aerial form of the 'Hairy Root'" and finally develop into the type of trouble first mentioned in this article.

A very similar trouble to this on pear twigs we have described elsewhere in this Report as due to winter injury. Because of our uncertainty that the crown gall germ is always responsible for these two injuries they are described here both as physiological and bacterial troubles.

Mice Girdle. Each year, during the winter season, mice cause more or less injury to trees by eating off the bark at their base. Some years, however, the injury is much more serious than in others, and when there is an abundance of snow on the ground the injury seems to be worse. Apple trees suffer more than any others though complaints have been made of injury to peach, maple, Scotch and white pine. The winter of 1919-20, with its abundant snowfall, apparently was the worst of any yet noticed. Even poison ivy was girdled along fence rows. In a nursery we saw considerable injury to Japanese maples and other ornamental plants. Reports were received of serious injury in many apple orchards, and to a less extent in peach orchards, to both young and old trees so that many thousands of fruit trees in the state were thus girdled. Most of this injury occurred below the snow line. We will not discuss the trouble further here, but refer the reader to the special article on this subject by Mr. Stoddard recently issued by the Station (Bull. of Inf. 10: 1-7. *Figs. 1-8.* Mr. 1920.).

Smoke Injury. In July, 1919, a letter was received by the Station from C. A. Burley of Stamford in which he wrote: "I have an orchard which (I think) is being killed by smoke from a factory alongside of it. In fact several of the trees are already dead and the others very weak. I would like very much if you could send someone to look over the situation." Soon afterward the writer and the state forester, Mr. Filley, went to Stamford, and with Mr. F. A. Bartlett and one of the parties interested examined the orchard and the vicinity for the cause

A suspicious thing, in the mind of the writer at least, was the presence, about in a direct line a quarter of a mile away but lower down near a stream, of a chlorine factory that was used during the war by the government for making chlorine gas but now abandoned. An examination of the vegetation, especially the trees immediately around this factory, showed no injury except to a few trees on the edge of the stream into which had been emptied considerable chemical refuse from the factory. In other words as there seemed to be no indication here of injury to the trees or herbaceous vegetation from possible escaping fumes, there was no likelihood of the trouble in the orchard being due to such a cause.

The orchard, however, bordered directly on one side of the buildings of a bronze factory, through the open windows of which were blown the minute particles from the burnished bronze. More or less of this dust settled upon the surrounding vegetation and could be distinctly seen as minute golden particles on the apple leaves even some distance away. The man who showed us around thought that the bronze dust was responsible for the injury to the trees. At first sight this also seems plausible, as the apple leaves where the dust was most abundant had numerous small reddish specks often immediately under the bronze particles. An examination of the vegetation immediately under the factory windows where the dust was thickest, showed no evident injury on such tender leaves as pokeweed, burdock, *Bidens,* etc. It seemed probable, therefore, that this dust caused no harm, unless possibly on long standing some unknown chemical change took place that produced these specks and even then this would not account for the death of the trees and the severe scorching of the foliage elsewhere. The smoke from the factory was carried off by a high stack, with the wind mostly taking it away from the trees, thus eliminating this as a factor. In the rear of the factory, was a temporary incinerator with a low stack for burning rubbish including the waste that was used in burnishing the bronze. The smoke from this was strong and could be easily carried, with the wind in the right direction, over the apple trees. In fact it was in an extension of the orchard nearest this that most of the dead trees occurred. From what we have seen of smoke injury elsewhere, this seemed to us to be

the most logical source of the injury. Just what chemical matter was included in this waste that could cause the injury we did not determine, but if sulphur was present it could have been responsible.

Winter Injury Cankers. The severe winter of 1917-1918 did great harm to various trees in this state, especially to cultivated ones and particularly to peaches and apples. We have in previous Station Reports discussed various forms of winter injury to the apple, and in the Rept. of the Conn. Pom. Soc., vol. 21, p. 102, 1919, have given a brief resumé of these including the trouble mentioned here. We wish in this note merely to mention this unusual form of winter cankers not noted before in our Station Reports. One of the worst injured orchards that we saw was that of W. B. Johnston, of South Meriden, who had us examine it in June as he thought he had some unusual disease.

The orchard, chiefly Baldwins, was on an exposed hill that got a full sweep of the winter winds and had shown no such injury the previous season. Trees that bore heavily the previous fall were those that suffered the most winter injury. Besides the dead and badly injured trees, there were some that showed irregular dead areas on the trunk or elongated dead areas on the limbs that looked like disease cankers as they were sharply marked off by cracks in the bark from the living tissues. Often these showed fruiting pustules, thus increasing the impression of their fungous origin to one not acquainted with the facts of the case. A peculiarity of the cankers in many cases was their situation *on the lower side of branches* with the upper side healthy or only slightly injured! Just what caused this difference in susceptibility to injury we do not know. Possibly the tissues of the upper side were more matured or contained less water. Such cankers on the under side of branches were not infrequent in other orchards following this severe winter.

Ash, White, *Fraxinus americana.*

ANTHRACNOSE, *Gloeosporium aridum* Ell. & Holw. We have reported anthracnoses before on maple, oak and some other trees, but in the summer of 1919 we received for the first time specimens on white ash. They were sent, early in June, both by Miss Jessie H. Brown from Lyme and H. O. Taylor from

Cobalt, who complained of the trouble as a serious one causing more or less defoliation of their shade trees. In the first case at least, the leaves were also attacked by the rust mentioned below. The disease appeared on the leaves as they were reaching maturity causing a scorch-like burn usually involving considerable area from the margin inward; occasionally there were smaller isolated spots within. The diseased area was somewhat translucent, of a light or yellowish-brown color, sharply marked off from the healthy tissues and easily broken when dry. The very inconspicuous fruiting pustules were seen with a hand lens more or less abundantly imbedded in the lower surface. The wet spring weather was very favorable for this as well as other true anthracnoses.

Four different species of anthracnose have been reported on this host and at least one or two on other species of ash. So far as we can determine from the printed description, our specimens agree best with the species given above which was published by Ellis and Everhart in the Journ. Myc., p. *21*, *1887*. The specimens upon which this species was based were received from J. J. Davis of Racine, Wis. Davis (Trans. Wisc. Acad. Sci. Arts 9: 169.) in 1892 erroneously gave the authority for the name as E. & E. He writes, "Abundant. When developing vigorously on exposed trees it attacks one edge of the leaf, causing it to curl toward the affected side. When less vigorous on leaves of shaded trees it occurs on roundish spots about 5 mm. in diameter."

The spores as we find them are hyaline, oblong or broadly oblong, slightly pointed at the ends, straight or very slightly curved, 6-10μ by 2.5 - 3.5μ but chiefly 7-9μ by 3μ. *Gloeosporium irregulare* Peck, described shortly after this species, does not seem to differ materially from it except in the greater width of the spores (4-5μ) as given by Peck. Recently we have received typical specimens of *G. aridum* from Davis, and of *G. irregulare* from House, and both express the opinion that they are the same species. Our examination of these specimens also confirmed our suspicions that this was the case. Dr. House writes, "I think there is no question as to the identity of *irregulare* with *aridum*, apparent differences in the measurements given in the description are not borne out in the specimens. I enclose a bit of the type."

RUST, *Aecidium Fraxini* Schw. Plate XXXV, c. We have illustrated and briefly described this rust in previous Reports (Conn. Agr. Exp. Sta. Rep. 1903: 304. *Ibid.* 1911-12: 343.) as occurring not uncommonly on the blades and petioles of the white ash in this state. During the early summer of 1919 it was more abundant than we have ever seen it before. It was sent in several times as causing more or less injury to the lawn trees and was said to cause severe defoliation in one case. In our collection this year we found the rust not only on the blades and petioles but also on the young stems of this year's growth, the maturing winged seeds and the staminate blossoms which had been curiously transformed through the action of the phytoptus mite occurring on this host. The mycelium causes more or less distortion of the infected parts and this is especially so on the branches, where it produces gall-like growths, covered with the aecial stage, and often involving the young axial parts, as shown in the illustration. When young the aecia are elongated but wear away in time to short cups. Farlow (Proc. Soc. Prom. Agr. Sci. 9: 26. 1888.) reported a serious and extended outbreak of this fungus in 1885. Arthur (Bot. Gaz. 29: 275.) reports cultures made in 1899, and several times since, with the III stage of a *Puccinia* from *Spartina* sps.; he produced the I stage on *Fraxinus lanceolata*. He calls the fungus, therefore, *Puccinia fraxinata* (Schw.) Arth. So far as we have found, no one has infected other species of *Fraxinus* with the *Spartina* rust. Arthur however failed in several attempts with other genera in the same family as *Fraxinus*. While this rust is common along the Sound where *Spartina* also occurs, we have often seen ash trees badly affected quite removed from any specimens of it. Our efforts, however, to obtain any further clues of relationship met with failure. We tried several times to inoculate species of *Agropyron repens, Poa pratensis, Spartina* (large and small) sps., and even leaves of *Fraxinus americana,* with the I spores from the last host without result.

Asparagus, *Asparagus officinalis.*

ANTHRACNOSE, *Colletotrichum* sp. On Burr's Mammoth Asparagus at the Station farm, the latter part of September, 1919, we noticed a conspicuous disease on the green stems that

we had not seen before. This was causing more or less injury to the infected plants. Irregular, often elongated, grey areas, of greater or less extent, appeared in the normal green skin; in these were numerous very small but conspicuous, black fruiting pustules. The center of these often showed a white spot evidently where the spores were discharged. The spores are hyaline, narrowly to broadly oblong, often somewhat pointed at one end and 12-17μ long by 4-6μ wide. The fungus is evidently that briefly described and pictured by Halstead (N. J. Agr. Exp. Sta. Rep. 1896: 410.) in 1897 but of which he gives no description of the spores, etc. There are no setae on the fruiting pustules of our specimens so that the fungus looks as much like a *Phoma* as a *Colletotrichum*. Several species of each of these genera have been described on asparagus, but all appear to be on the dead stems and none quite like ours. We have found no further reference to Halstead's *Colletotrichum* sp., and Cook writes that there are no specimens of it in the herbarium at New Brunswick. On our specimens, often in the same spots, there is also a *Fusarium*, previously mentioned by us (Rep. 1903: 305.). This probably has no connection with the *Colletotrichum* and seems to form more definite elliptical or elongated spots with a distinct purplish border, but it is difficult to tell, in some cases, which fungus caused the spots. It may be that both are languishing parasites on the older stems or that one follows the other as a lesser parasite.

Fasciation. Harshberger in his book (Mycol. Plant Path.: 329.) describes fasciation as follows: "Fasciation in its simplest form consists of a flat, ribbon-like expansion of stem, branch, flower clusters, flowers and fruits which may be cylindric below, but flattened above." Sorauer (Handb. Pflanzenkr. 1: 332.) says concerning these fasciations: "We may likewise consider as due to local over-nutrition, the condition arising when a cylindrical branch becomes broad and flattened. It then looks as if a number of branches had grown together; nevertheless, this is only rarely the case, for almost always only a single branch is involved, which, by broadening its vegetative point, no longer has a vegetation cone at its apex but a comb-like vegetative surface." The last writer also states: "We have seen already in roots held fast between split rocks that pressure from two

opposite sides may give the axis a band-like form. Under certain circumstances such a changed direction or growth may continue if the cause of arrestment itself has disappeared." Cowles (Text Book Bot. 2:786.) writes: "The phenomenon is not well understood, but often it is believed to be associated with 'over nutrition'; sometimes it is produced by mechanical causes, or by insect or fungal activities (as in *Œnothera*). Fasciation sometimes appears to be inheritable, but this remains to be established, at least as a general proposition."

Mr. Frank Hanchett of Falls Village, Conn., brought to the Experiment Station during the winter of 1918 a specimen of asparagus (partly shown in Plate XXXVI, a, here) taken from his garden the summer previous, that showed evident fasciation. The stem was flattened so that when green it was two and a half inches wide across the base as against half an inch in thickness. The stem as brought to us was about two feet long and was flattened the entire length. The apex was narrowed and twisted into an irregular spiral coil of two and a half turns. About half way down, the specimen branched but the second branch was broken off a short distance above its origin so the nature of its apex was not disclosed. Sections made through the stem showed abundance of the mycelium of some fungus scattered somewhat irregularly through its length. These threads were much more abundant in spots, evidently developing best in the vicinity of the fibro-vascular bundles, especially in the pith cells surrounding them and in the vascular ducts. Concerning the identity of the fungus we could not be sure because no definite spores were seen, but it appeared to be a *Fusarium*. There may have been some connection between the presence of the fungus and the fasciation, but we cannot be sure.

Keeping this malformation in mind we unearthed several examples of fasciation of asparagus during the spring of 1918. These came from Milford, North Haven and Middlebury, so this trouble cannot be considered very rare. We did not find in these subsequent specimens the mycelium of any fungus though all were not carefully examined. The largest of the two or three specimens from the Whittemore estate at Middlebury was about 3 feet long and showed short bifurcated and slightly coiled tips. The specimen from the Clark Wilcox place at Milford

was by far the most striking, being at least five feet long and the flattened side of the stem three inches wide, with numerous branches scattered along its sides in the axils of the scale-like leaves, as was the case with the other specimens. The stem was coiled in one complete turn near the center but the nature of the tip was obscured though probably slightly bifurcated.

In 1919 market agent Stack brought us a specimen purchased in the New Haven market, and in 1920 other specimens were found in the Station's asparagus bed. Efforts in 1920 to produce this flattening by various artificial methods involving pressure on the growing tips were apparently not successful; but further work along this line will be done.

Besides these fasciations of asparagus, we briefly describe in this Report somewhat similar troubles on Larkspur, Pea Shrub, Rose and Sumac, and previously (Rep. 1913: 6. 1914.) we have described and figured the same thing on a young apple twig. Besides the flattening of the stem, common characters with most of these fasciations are the bifurcation and coiling of the tips.

Bean, *Phaseolus vulgaris.*

BACTERIAL WILT, *Bacteria* sp. Plate XXXVI, c. Several times in the early summer of 1918, we had complaints of young beans in war gardens dying from a scorch-like wilt. We did not have opportunity to thoroughly investigate all of these complaints, but such plants as we did examine led us to conclude that the trouble was not primarily a sun-scorch but resulted from invasion of the vascular system by bacteria. These eventually more or less completely cut off the water supply, with resulting wilting and scorching of the leaves under exposure to bright sunlight. The spring and early summer had been unusually wet and so favored bacterial invasion of the stem through injuries of the roots. Some of the specimens examined showed as yet little wilting of the foliage but evident invasion of the vascular ducts both in the stems and the leaves. Often the invaded tissues were apparently little injured; occasionally bacteria were found in the pith of the stem as well as in the ducts. A peculiar case shown us by F. J. Reveley, supervisor of war gardens at East Haven, was in a garden of eight rows of beans, four of which had the trouble badly, while the other four were

apparently free. Some bacteria, however, were found in the plants of the unaffected rows. The only difference, so far as we could determine, between the affected and unaffected was that the latter had a little more shade!

While there is a bacterial disease causing a spotting of the leaves of beans, the trouble mentioned seems to be another thing altogether. It is more like the bacterial wilt of cucurbits, but whether, as in that case, caused by a definite organism we do not know. We have seen no references describing such a trouble of beans.

Beech, *Fagus* sps.

Gas Injury. Through the kindness of Mr. G. F. Herthal, tree expert, the writer, with the State Forester, was shown in August, 1919, a couple of beech trees on the Nathaniel Wheeler Estate at Bridgeport, that developed the unusual injuries mentioned here. The first tree was near a driveway under which passed the gas supply to the house. The tree for at least the past two years had developed a serious injury of the leaves soon after they matured. This showed as a scorch, chiefly at the margins, and caused more or less defoliation. Otherwise the tree looked healthy and there was no apparent fungous or insect cause for the trouble. As the scorch had a similar appearance to gas injury that we have seen on maple trees on the streets, we finally concluded that there was a slight leak from the gas pipe in the road that caused injury to the roots and thereby affected the leaves.

Lightning Injury. In this same yard there was a very old and noble copper beech which a number of years before had been struck by lightning. The most evident effect was the killing of the bark at the base of the tree so that at this time it was entirely girdled, except for a slight connection on one side with a large root. While the tree had been trimmed of a large dead branch in the past and had one nearly dead main branch on one side, it still maintained evident vigor of the main very large branches despite this almost complete girdling at the base.

Bitter Sweet, *Celastrus scandens.*

Chlorosis. This was merely a case of yellowish-white spotting of the leaves, most frequently near the margin. Some leaves had yellowish areas instead of the small definite spots. This

trouble may have resulted from some insect sucking the juices from the leaves when they were quite young, but it was more likely due to the late frosts that came early in May, as we have seen somewhat similar injury caused on other plants. See Frost Injury under Tobacco. The specimens were found in June, 1919, on a wild plant at East Haven, but may be looked for on cultivated ones, as some of the cultivated species have variegated foliage.

Blackberry, *Rubus* sps.

ORANGE RUST, *Caeoma nitens* Schw. Germination tests so far made show that this rust on cultivated *Rubus villosus* (Gray's 6th ed.) in this state belongs to the short cycled form. This rust was found doing serious damage to a certain variety in a plantation in Westville in 1919. On the wild blackberries, likewise, all germination tests of the collections show the rust to be this form, except one which was long cycled, and later collections disclosed the III stage of *Gymnoconia interstitialis* on this same plant. See "Raspberry" for further details.

Box, *Buxus sempervirens* var. *suffruticosa*.

Winter Injury. From time to time during the past years, there have been sent to the Station branches of box in which the leaves were dead, having a yellowish-white color, and complaint was made that the whole plant or part of it was in this condition. Search has sometimes revealed immature stages of some fungus developing in these dead leaves or branches, but no definite indication has ever been found that such a trouble was due to the attack of a particular parasite. Sometimes we have seen individual plants in the nursery showing this trouble, and we have wondered if it might not be the result of sun scorch.

After the severe winter of 1917-18, we saw so much trouble of this nature on box hedges that we could not but conclude that most, if not all, of these troubles trace back to severe winter injury of the leaves, stems or roots. We saw one hedge at the Whittemore estate at Middlebury in the spring of 1918, where the upper branches and leaves were all killed while those below were uninjured. In this case the hedge had been protected during the winter by an artificial covering but this did not reach the tops of the plants, with the result that the parts exposed were thus injured. Box is not entirely hardy so far north as this and

in severe winters some mulch protection, either artificial or snow, is usually needed to prevent winter injury. The winter of 1917-18 was so severe that many unprotected hedges were ruined. Why in some hedges certain plants are badly injured and others escape, we cannot surely say, but this may be due in part to the immaturity or the weaker condition of those affected.

Butternut, *Juglans cinerea*.

STAGHEAD, *Melanconium oblongum* Berk. We have not made personal observations on this fungus but have had it called to our attention by Dr. A. H. Graves who has made a study of it in this and adjacent states. He holds the view that it is largely responsible for the dead limbs so frequently seen on butternuts, and finally for the stag-headed appearance of the trees due to the death of the tops. A discussion of it by Dr. Graves appeared in Mycologia 11: 111-13, in May, 1919.

Cabbage, *Brassica oleracea*.

BLACK LEG, *Phoma lingam* (Tode) Desm. (*P. oleracea* Sacc.) Plate XXXVI, b. We have found this disease only twice in this state and then under conditions that were very unfavorable to the cabbage plants. It was first called to our attention about the middle of November, 1918, at the D. L. Clarke & Sons' farm at Milford. Cabbage plants had been set out very late in their field during dry weather. The plants used had been kept too long in the seed bed, and so were over-sized being long and spindling. They were dropped in a furrow, watered and then set in by tramping the earth around them with hoe and foot. The plants as a whole did very poorly, many died and others failed to make much of a growth, so that about 90% were failures. When seen by us the stem underground and partly above was badly withered, or decayed in many cases, as shown in the illustration. The fruiting pustules of the *Phoma* could be seen on most of the stems, but on others the fungus was not evident. The same fall at the Experiment Station farm at Mt. Carmel, we found a few freak plants in the club-root experiments that showed the same trouble.

The disease was first called prominently to the attention of cabbage growers in this country by Manns (Ohio Agr. Exp.

Sta. Bull. 228:276-90.) of Ohio in 1911. It seems to be a trouble that starts in the seed bed but becomes most serious and conspicuous after transplanting in the field. The disease starts on the stem as a white sunken area, usually near the junction of a leaf petiole, eventually forms serious cankers or girdled areas, invaded by bacteria, etc., and becomes black in color, hence the common name of "black leg." The fruiting pustules are easily made out in the infected areas as small black dots. The spores are hyaline, oval to oblong and chiefly 3.5-5μ by 1.5μ-2μ. More recent investigations (Wisc. Agr. Exp. Sta. Res. Bull. 38:6. 1915.) show that *Phoma oleracea* Sacc., as it is called by Manns, is a synonym of *Phoma lingam* (Tode) Desm.

Cabbage, Chinese, *Brassica pekinensis*.

Leaf Mold, *Alternaria Brassicae* var. *macrospora* Sacc. This fungus forms small, rounded, blackish, zoned spots on the leaves. We noted it, in 1916, from the Station's farm at Mt. Carmel, as "quite bad on some varieties." Apparently no specimens were saved so nothing further can be said of it.

Leaf Spot, *Cercosporella albo-maculans* (Ell. & Ev.) Sacc. This forms conspicuous greyish spots, with a more or less dis tinct border, that are from a quarter to half an inch in diamete In dried specimens some of these spots retain a more greenis color than the rest of the leaf. Our specimens were collected o Aug. 30, 1917, at the Station's Mt. Carmel farm. So far as w have learned, the fungus has not been reported before on thi host, at least under this name. We have had considerable troubl in identifying it because from the dried specimens it is quite diffi cult to determine how the spores are borne.

Alternately we have considered it under the genera *Cercospor* *Cylindrosporium* and *Cercosporella*, since species on *Brassica* ar described under each of these that fit our specimens fairly wel especially as regards the spots and appearance of the spore *Cercospora brassicicola* P. Henn, described in 1905 from Japa on *Brassica sinensis*, however, seems not to be the same sinc the hyphae bearing the hyaline spores (40-80μ long) are said t be *dark colored* and 20-25μ long. We could find no such definite hyphae associated with the spores. If the author has mistaken other hyphae of saprophytic species that rarely occur on old spots,

we may have what he has described but we have no specimens for comparison.

Cylindrosporium Brassicae Faut. & Roum. (Rev. Myc. 13:81. 1891.) seems to fit our specimens even better as the spores are said to be 80-120μ long (forma *Napi,* however, in Roum. Fungi sel. no. 6727, only 40-80μ) but they are enclosed *in the parenchyma.* Our study of these dried specimens (Roum. Fungi. sel. nos. 5679, 6727, 7318) leads us to believe that the writers were misled in their conclusions as to the origin of the spores and that they are really borne on the outside on short hyphae as in *Cercosporella.* Perhaps further study of fresh specimens from France is needed to definitely prove this point. This name antedates any of the others.

Cercosporella albo-maculans (E. & Ev.) Sacc., originally described as a *Cercospora* (*Cercosporella*) on *Brassica campestris* from California (Proc. Phil. Acad.: 378. 1894.) was placed definitely under *Cercosporella* by Saccardo (Syll. Fung. 11: 606.) because the hyphae (8-12μ by 2μ) bearing the spores were decribed as hyaline. The spores are given as 40-68μ by 2-2.5μ. Except for this somewhat smaller size of the spores the description agrees very well with our specimens. These latter we find to vary from 50-105μ (chiefly 65-90μ) by 2.5-3μ. They are hyaline, straight or somewhat curved and septate. The septa are more or less evident, usually three being found, but with staining even four to six can sometimes be made out. After much examination we definitely determined that the spores are borne externally on very short, inconspicuous, hyaline hyphae no wider than the spores. These may be somewhat grouped or isolated, and come from the stoma or directly through the epidermis. As the spores are easily broken the size given for them may vary according as one measures them whole or broken. We have seen a fragment of the type of *C. albo-maculans,* sent us from the N. Y. Bot. Garden, and found the spores to vary from 45-85μ by 2.5-3μ and as these measurements agree fairly well with those from our specimens we have adopted this name though we have small doubt as to their identity with the French specimens described under *Cylindrosporium.*

SOFT ROT, *Bacillus carotovorus* Jones. Plate XXXVII, a. In the summer of 1918 a serious disease took off at least ten per cent

of the Chinese cabbage grown at the Station's Mt. Carmel farm. The outer leaves would wilt, drop over, turn yellowish and finally the whole plant would go down. An examination showed that the trouble was of bacterial origin and the dropping of the leaves was due to the rotting of the tissue at the base of the petiole and in the stem. When cut lengthwise through the stem, there was revealed a rotting mass that in time became hollowed out as shown in the photo. Sometimes the rot finally extended up the mid rib and even into the leaf blade. The wet season may have favored this trouble since the cabbage was grown on soil not in this crop before and very little manure was used; however, the rot was not very prevalent either the year before or after 1918, although 1919 was even more moist than 1918. The variety called Wong Bok seems to have been most subject to the rot.

While we made no special bacteriological study of the rot, it was so similar to the ordinary soft rot of cabbage and other vegetables previously recorded from this state, that we have little doubt that the usual soft rot organism was responsible for the trouble. Recently Brown and Harvey (Phytop. **10**: 81-90. Fe. 1920.) have described a similar bacterial rot of Chinese cabbage and have noted besides the rot a spotting of the leaves due to the same cause. They think, however, that, while the soft rot is due to different bacteria, the trouble really starts through invasion of the bundles by *Pseudomonas campestris*, the black rot organism of cabbage, etc.

Carrot, *Daucus Carota*.

Drop Rot, *Sclerotinia Libertiana* Fckl. Carrots bought from a grocery store by the writer in the winter of 1919-20 developed, on their outside, while stored in the paper bag, a rot with the conspicuous white mycelium and large black sclerotia of the above fungus. We have found the same fungus causing drop of lettuce and parsley in the greenhouse and dampening-off of seedling beets in hot beds (Rep. **1908**: 860, 863, 868.) A similar fungus of doubtful identity has been reported by us as causing a rot of stored cabbage (Rep. **1915**: 428.).

Celery, *Apium graveolens*.

Root Rot, *Pythium deBaryanum* Hesse. Mr. E. B. Hall of Middletown in September, 1915, sent us specimens of celery hav-

ing stunted roots more or less rotted off. An examination of these revealed the oospores of a *Pythium*-like fungus in the tissues. We did not determine the fungus more definitely at the time, but our recent study of a variety of similar troubles led us to re-examine the celery specimens and decide that the fungus was *Pythium deBaryanum.* In size and general appearance the oogonia and oospores are the same as those found in the Spinach trouble, *q. v.,* discussed elsewhere. In these old dry roots of celery, however, the oogonia have become thicker and wrinkled somewhat as shown in Plate LVI, 5. Very similar wrinkling however, is developed in the older artificial cultures of this *Pythium* when dried out, as shown in Plate LVI, 8.

Complaint was made of serious injury to the celery but whether or not this fungus was the chief cause could not be determined from the specimens received, as there was also a bacterial rot of the stems present, in some plants. In Aug., 1918, we had called to our attention a root rot of Golden Self-Blanching celery on the farm of W. G. Griswold at Wethersfield. This was so far advanced that the primary cause was not determined though *Fusarium* and bacteria were at least subsequent agents. A careful search for *Pythium,* however, was not made. It seems quite probable, however, that *Pythium deBaryanum* may often be the starting point of such root and stem rots.

Crinkle. Plate XXXVII, b. The illustration shows the contrast between a normal leaf and one with the crinkle. This trouble was called to the writer's attention, the last of August, 1918, by Mr. H. D. Peters of Highwood. He said the trouble appeared rather suddenly in his celery field and that the same seed had not shown it the year before. At the time of our examination the plants seemed to be outgrowing the trouble, as the newest leaves did not show it to any extent. Crinkle develops on the leaves as numerous small puckers or larger folds as if the lower surface had grown faster than the upper. Sometimes the segments of the crinkled leaves are much narrower than those of the normal leaves. Occasionally the color of the leaf is a lighter green but the general appearance is not like that of mosaic.

Evidently the trouble is developed in the young growing leaf and not after it is matured. No signs of lice were present and the folding was toward the upper surface rather than the lower,

the way lice normally injure the leaves. When the plants were set out early in July the weather was rather dry, they had not been watered, and their first leaves showed no crinkling. It seems probable since the central leaves showed the trouble most conspicuously that it was caused by a rather sudden change from the dry to the wet weather that followed with abnormally fast growth compared with that previously made, resulting in faster cell development on the lower side and the crinkling. In time the plants become acclimated to the change with a gradual return to the normal type of growth. Sanford White (see Plate XXXVII) was the variety that showed the trouble by far the most conspicuously though it was seen somewhat on Salzer's Early Bleaching.

Corn, *Zea Mays.*

ANTHRACNOSE, *Colletotrichum graminicolum* (Cesati) Wilson. The disease shows on the leaves of this host, at first, as small oval or elliptical spots containing more or less evident fruiting pustules. If numerous spots occur, the intervening tissues are soon killed so that elongated irregular, brownish areas run lengthwise of the leaf obscuring the smaller spots, and the tissue may become more generally invaded. The setae are prominent on the fruiting pustules and are blackish straight spines about 6 to 8μ wide at the base and 60 to 120μ long. The spores are hyaline, occasionally straight but chiefly decidedly curved and broadest near the center tapering to a decided point at the free end. They vary from 24-30μ by 5-6μ. We have found this fungus in this state twice, collecting it once in July, 1919, on leaves of Golden Bantam sweet corn at the Frank Beach farm in Woodmont. Here the fungus occurred as a parasite but did not seem to be causing any very conspicuous damage, being confined largely to the lower smaller leaves that sooner or later die anyway. The other collection, made on Aug. 24, 1918, was on the stalks of sweet corn from the same general neighborhood. The stalks had been collected for the Fusarium root rot mentioned later, and were kept for some time in paper bags where the *Colletotrichum* probably developed as a saprophyte.

This fungus was first presented in detail from this country by Selby and Manns (Ohio Agr. Exp. Sta. Bull. 203: 187-211. 1909.). Manns described it as a new species, *C. cereale*, and

found it was causing more or less injury to various cereals and grasses, being especially bad on wheat and rye, since it attacked the heads and caused withering of the grain. He found it on the leaves, heads, stems and roots of its different hosts, but he did not include corn among these. Later Wilson (Phytop. 4: 106-112. Ap. 1914.) made a special study of the nomenclature of the fungus and decided it was an old species that had received about a dozen specific names in the past and he adopted the one given here as the authentic name. He gives *Zea Mays* as a host, in fact the earliest collection in 1852 from Italy being in part on it. He also lists it on this host from Connecticut, New Jersey, S. Carolina and W. Virginia in the United States. The citation on *Zea Mays* from Conn., collected by Rorer, apparently is intended for *Sorghum vulgare,* since we have it in the Station's herbarium on this, and Wilson credits it to *Sorghum* only from this state in the main part of his paper.

We have not seen any reference in literature where the fungus was claimed to be an active parasite of corn, most of the collections apparently having been made on the dead stalks. While the size of the spores as found by us on corn are larger than those given by Manns, they are not larger than found by Wilson on some of the hosts and are similar in appearance and size to those found in the Rorer specimen on *Sorghum* (Conn. Rep. 1903: 358.). On this latter host, however, the spotting is much more conspicuous being very decided reddish-brown on the green leaves. It is commonly known as *Colletotrichum lineola* Cda. on this host.

PURPLE FUNGUS, *Monascus purpureus* Went. This fungus was isolated in Dec., 1916, from New Milford corn silage sent by L. W. Marsh who thought that the silage was causing the cattle fed on it to scour. Later he came to the conclusion that that was not the cause of the trouble. An examination of the silage showed many of the corn fragments of a decided reddish-purple color and on these by close examination a moldy growth of this fungus in fruiting condition was found.

The only reference we have found where this fungus was suspected of having caused injury is in Pammel's Manual of Poisonous Plants, p. 247, where he says: "The family *Monascaceae* contains one fungus which has been found in mouldy corn and silage in Iowa, the *Monascus purpureus* Went. * * * The

coloring matter from *M. purpureus*, known as 'ang-quac,' is used in Eastern Asia as a pigment, being produced by the growth of the fungus on rice. * * * Dr. Buchanan found this species in spoiled corn silage, which was responsible for the death of several horses in Iowa. This species possibly has been the cause of the disease, this fungus occurring only where air had access to the silage."

Concerning the coloring matter produced by the fungus Lafar (Tech. Myc. 2: 10. Salter trans.) says: "To impart a red colour to rice wine, to various spirituous liquors, bread, cakes, and to the fish held in such high esteem (under the name of Macassar or red fish) in the Malay archipelago, the Chinese employ a colouring matter extracted from a red Hyphomyces, which they cultivate on boiled rice. The fungus grows with vigor on this medium, and imparts thereto a red coloration; and the dried cultures, to which a preservative addition of arsenic and mustard oil is made at the time of preparation, form an article of commerce under the name Ang-Khak. C. Went. has named this fungus *Monascus purpureus*."

This commercial use would indicate that the fungus was at least not a very poisonous species and it is probably entirely harmless. Even when silage does produce illness in cattle the real cause of the trouble is quite an open question, indigestibility, bacteria and various fungi all coming in for consideration. Apparently as yet no organism has been isolated and fed directly, producing similar trouble, to prove its connection.

ROOT AND STALK ROT, *Gibberella Saubinetii* (Mont.) Sacc. In August, 1918, in company with Dr. Hoffer of the Indiana Station, we examined fields of sweet corn, grown for seed, in the towns of Orange and Milford, to determine if the *Fusarium* root and stalk rot, so serious in the sweet corn fields in Indiana, was present here. Connecticut supplies much of the seed of sweet corn grown for the canneries in the west. We found this trouble in small amounts in various fields of such varieties as Crosby, Evergreen, Howling Mob, Country Gentleman and Golden Bantam. It was only in a single field of the last variety, however, that the trouble was conspicuous enough to attract serious attention, as about 5% of the stalks here were injured. As shown to us by Dr. Hoffer, the trouble may start from the seed as a primary

infection, or it may possibly get into the young plant later through injuries of the roots. In time the roots are more or less rotted and the lower portion of the stalk invaded. By cutting stalks lengthwise from the base up, the infection is shown by the discolored and diseased tissues at the nodes for a shorter or longer distance according to the progress of the fungus upward. The lower leaves die prematurely and the stalk is often barren, especially in the west, and is easily blown or broken over. The trouble was seen again in 1919 on sweet corn, but as yet we have not looked for it on field corn where it probably also occurs.

While we have made no particular study of the cause of the disease we do not doubt that it is sometimes carried in the seeds, apparently through secondary infections according to Hoffer. However, we should judge, since it is not a very serious trouble here, that the infected soils of the west were more a source of infection there than Connecticut seed. We shall speak more of this matter, however, under "Poor Seed."

Hoffer, Johnson and Atanasoff (Journ. Agr. Res. 14:611-12. 23S. 1918.) have recently proved the identity of the *Fusarium* of corn root rot in the west to the *Fusarium* causing scab of wheat, etc., which is so prominent in that region, and have connected these with a mature stage belonging to the genus *Gibberella*. This stage has also been found on old corn stalks recently in Connecticut fields. The ascospores of this are hyaline, four-celled, straight or slightly curved and chiefly 24-30μ long by 5-6μ wide. Ellis issued (N. A. F. no. 81, under the name of *Nectria* (*Gibbera*) *pulicaris* Fr.) what appears from our specimens to be a different thing on old corn stalks.

On one of our specimens we also found *Diplodia macrospora* Earle, fruiting abundantly. What connection, if any, this fungus may have with the root rot we do not know. *Diplodia Zeae* (Schw.) Lev. is reported as a serious disease of corn in Illinois (Ill. Agr. Sta. Bull. 133.) and Farlow and Seymour (Host Index: 156.) give it as a synonym of *Gibberella Saubinetii* Sacc.

Yearly rotation of corn, care being used not to follow wheat or rye, and the use only of healthy vigorous seed, are methods for limiting this trouble to minimum injury.

Root Rot, *Phytophthora cactorum* (Cohn & Leb.) Schroet.

There were various complaints in 1919 of corn not doing well, and the cause was not always evident from the information and specimens received. Some of the trouble may have been due to the *Fusarium* already mentioned, or to the leaf blight, *Helminthosporium turcicum,* which killed the leaves as if by a frost, especially in late planted sweet corn. In other cases apparently neither of these fungi was the responsible agent. An unusual case was called to our attention late in the fall by County Agent Southwick of Hartford who sent us corn stubble for examination and wrote as follows:—

"I got them from John Cannon who lives in North Granby. This particular field raised a good crop of corn last year but had no other fertilization this year than a thousand pounds, I believe, of a 3-10-0 fertilizer. The corn was backward early in the season, and on two adjacent fields as well as part of this field cottonseed meal was applied during the summer. Wherever the cottonseed meal was used the corn seemed to recover and made very satisfactory growth. This particular field, however, never made very much growth and was about the size of pop corn although it should have been good-sized yellow flint. Mr. Cannon says that when cultivating the corn it was easy to pull the whole plant out, as the roots seemed to be decayed, particularly in the center.

"I noticed in pulling up this stubble that some of the first roots had apparently disappeared and that secondary roots, although small in size, had developed. The application of cottonseed meal could be determined right up to the last row of corn, because in this field it was impossible to pull out the stubble where cottonseed meal was used, but the next row to it was like the specimens I send. I thought at first perhaps the fertilizer might have contained some borax, but nothing on the enclosed tag seems to warrant such an idea. Whatever the trouble was the cottonseed meal seemed to give the corn a new start so that a reasonable crop was secured."

It was of course too late for us to tell from the specimens sent the actual cause of the trouble, but we ran across a fungus that possibly may have had some bearing on it, and as we had never seen it before on corn, we have thought it worth while mentioning even if it should finally prove to be merely a saprophyte. In the pith of the stubble when cut across we found in the vicinity of the nodes the oospores of a fungus, see Plate LVI, 1, more or less abundant. As there were no other stages with these oospores, and as no cultures were obtained, we were not sure at first whether they belonged to a species of *Pythium* or *Phytophthora. Pythium deBaryanum* has been reported as dampening-off corn seedlings (Fischer, Die Pilze 1^4:405.) but the oospores we found are too large for that species, and are enveloped too closely by the oogonium; besides, there was a good stand of corn in the field. The oogonia varied from 21-33μ but

chiefly from 24-30μ and the oospores from 18-29μ but chiefly from 22-27μ. The walls of the oogonia and oospores were hyaline, and those of the latter were quite thick (2.5-4.5μ.) As a rule the oogonia enveloped the oospores rather closely and likewise the spores agree fairly well with those of *Phytophthora cactorum* in other respects, though the cell wall appears to be thicker than usual on spores in artificial cultures.

Infection experiments with the culture of *Phytophthora cactorum,* obtained from Pear, were not very successful on corn seedlings either in Petrie dishes or in soil in crocks. We did, however, in the latter get one or two seeds that showed oospores developed in them and a slight invasion of the main stem of the seedling. We have observed a number of root rots of different plants, especially in 1919, that were caused by *Phytophthora* or *Pythium,* and these we have discussed further under Pea, *q. v.*

Albinism, or *Striped Chlorosis.* Cases are not rare in both field and sweet corn where the young plants instead of being normally green have a whitish or yellowish-white color, or have similar elongated bands running lengthwise of the leaves separated by the normal green tissues. The more complete albinos never grow to large plants, and even the others are often somewhat stunted and may not mature seed. In 1919 several cases of the striped chlorosis were observed in Golden Bantam Sweet corn in the writer's garden and on a similar specimen of field corn sent to the station by G. D. Stone from Windham County.

Dr. Jones of this Station has grown experimentally several types of such corn and finds that when seed is matured the trouble is perpetuated more or less definitely as is the case with a number of our variegated plants cultivated for ornamental purposes. Just what prevents the development of chlorophyll in certain portions of the leaf and not elsewhere, thereby giving rise to this peculiar striping, is not known. Davis (Ia. Acad. Sci. 24:459-60.) in 1917 conducted some experiments with chlorotic corn in Iowa that seem to show that this trouble is not communicated by handling or inoculation as is the mosaic of tobacco.

Pellucid Spots. Plate XXXVIII, a. The trouble shown in the photograph reproduced here was called to our attention during the summer of 1919. In June at Milford, Dr. Britton's men collected the first specimens from which the photograph was

made; and in July even more striking specimens were received from A. B. Case of West Granby. Dr. Britton was not able to identify the trouble as one caused by sucking insects, though it has somewhat that appearance. Neither did the writer in the fresh specimens find any fungus or bacterial agent as a probable cause. We place it here for the present as an indefinite physiological trouble. Later, in the dried herbarium material, sections showed some mycelium in the tissues but whether of a saprophytic or parasitic character could not be determined.

The pellucid, semi-watery, more or less zoned spots have somewhat the appearance of a bacterial trouble. In some specimens these spots are half an inch long and very numerous so that the intervening tissue is killed or the spots run together indefinitely. When first formed in the otherwise healthy leaf, they are quite striking in appearance. Usually there is a minute spot at the center which is apparently the point of entrance or starting point of the trouble. Mr. Case wrote: "The dead stalks like sample are scattered over the field, occasionally a whole hill infected, with good corn all around it, but usually only one stalk affected in the hill. There is one spot in the piece, however, covering two square rods, where nearly all the corn is affected. The corn was all fertilized alike."

Poor Seed. In 1917 corn, field and sweet, over much of the United States was of such poor quality that it was difficult to obtain seed of sufficiently high germination for the 1918 crop. While this was partly true of the Connecticut seed corn, apparently the corn here was not so severely hurt as in most other states. So that there was an unusual demand, from this state, for good field corn for seed purposes. Germination tests showed great variations in the corn, due in part to injury from the early frosts in the fall before the corn was thoroughly ripened, and in part to the poor care given in drying and storing afterwards. The severe winter of 1919-20 also produced somewhat similar injury but to a less degree. There is no question that, where corn is grown for seed purposes, as is considerable of the sweet corn in this state, more attention should be given to having it properly matured, dried and stored to avoid the injury that comes with cold weather. Much corn is stored in open corn cribs and great variation in germination of this

corn, after severe winters, is sometimes shown. Thoroughly dried corn or corn stored in warmer buildings does not seem to suffer so much.

Frost-injured corn usually develops wrinkles in the skin, that are quite visible to the naked eye. On germinating in the seed testers, this poor corn is also apt to become more or less moldy with a variety of saprophytic molds, much as does the *Fusarium* infested seed as shown by Hoffer. There is no doubt that such seed even if it does germinate will not give as complete or vigorous a final stand in the field as perfect seed. On the other hand it does not appear that the *Fusarium* is primarily responsible for the poor seed of 1919 so that we are not dealing with a serious field parasite that might be harder to control than poor seed due to improper conditions of harvesting and storing.

Cotoneaster, *Cotoneaster horizontalis.*

RED CANKER, *Tubercularia vulgaris* Tode. This fungus was abundant on some dead stems sent us in Sept., 1916, by the Elm City Nursery Co., from Westville. Presumably the fungus followed winter injury, as it seems to be more of a saprophyte than a parasite. We have seen it a number of times on trees winter-injured, especially on nursery trees not strictly hardy in this climate.

Cucumber, *Cucumis sativus.*

ANGULAR LEAF SPOT, *Bacterium lachrymans* Sm. & Bryan. This disease shows as evident angular spots on the leaves as if water soaked. These at first are semi-transparent, but later are more opaque, reddish-brown, dead areas from which the tissues easily drop out. The bacteria also are said to cause a soft rot of the leaf petioles and young vines, and from small watery spots on the surface of the fruit Burger believes there develops a soft rot in the interior. This disease was sent us once or twice from Indiana some years ago, but we have only one collection on cucumber from Connecticut in the herbarium. This was found on the leaves at Milford in June, 1918. Our impression is that we have seen it at other times, but did not definitely identify it or collect specimens. However, we did collect specimens on musk-melons many years before this.

There is some question as to who first mentioned this trouble. So far as we have determined, it seems to have been first described in a popular way in 1894 by Halsted (N. J. Agr. Exp. Sta. Rep. 1893: 354-5.). He found it on musk-melons and reproduced a photograph of an infected leaf, but gave no scientific name to the bacterium producing the trouble. The writer found the disease first in Connecticut on the same host in 1902, and briefly mentioned it in his Reports (1903: 331. 1904: 346.) under the Bacterial Wilt disease with which we thought it might possibly be connected. It was collected at Southington, New Haven, Montowese, and seemed to be not uncommon in 1902 and 1903, but we have not collected it since. Burger (Phytopath. 3: 169-70.) in 1913 was apparently the first to make cultures and give a scientific description of the organism, which he placed under the genus *Pseudomonas,* but he gave no specific name. More recently, Dec., 1915, Smith and Bryan (Journ. Agr. Res. 5: 465-76.) gave a comprehensive account of the organism, which they call *Bacterium lachrymans.* These authors believe they studied the same leaf disease but concluded that Burger had a different organism in the soft rot of the fruit. It is quite possible that this organism opens the way for decay of the fruit by the ordinary soft rot bacteria. Some authorities would consider *Bacterium lachrymans* as a *Pseudomonas,* as it has polar flagella.

Currant, Black, *Ribes nigrum.*

LEAF SPOT, *Septoria Ribis* Desm. This shows on the leaves as small, angular, brownish spots with a purplish border. The very minute, fruiting conceptacles are embedded as black dots in these. The linear spores are curved, hyaline, and chiefly 45μ by 1μ in size. The same fungus has been previously reported by us on red currants and gooseberries. The specimens on the black currant reported here were collected by the writer at the Nathan Hale homestead at Coventry, in June, 1917.

RUST, *Aecidium Grossulariae* (P.) Schum. This was collected on escaped black currants in North Stonington, June 20, 1919, by Mr. Stoddard of this department. It occurred on both the fruit and leaves. This was not the first collection in the state, however, as we have specimens in the herbarium on the same host

made by Thaxter at Green's Farms in 1889, and by Filley, near Bridgeport, in 1917. It has been reported before on cultivated gooseberries, but not on cultivated red currants, though it is quite common on various wild species of *Ribes* in the state.

Currant, Flowering, *Ribes odoratum.*

ANTHRACNOSE, *Glomerella cingulata* (Ston.) Sp. & v. Schr. The *Gloeosporium* stage of this fungus was found on the fruit of the flowering currant in a farm yard between Meriden and Middlefield, June 21, 1917, by the writer. The fruiting stage showed as numerous pinkish pustules on the half ripened berries. The spores were chiefly 12-15μ by 4-5μ. Apparently this fungus has not been reported, at least frequently, on this host. Saccardo described a species, *Gloeosporium tubercularioides,* as occurring on the leaves, but this, because of its wider spores, seems to be different from our species which we have also previously reported on the fruit of the red currant.

BLISTER RUST, *Cronartium ribicola* Fisch. Both the lemon-yellow dusty pustules of the II or summer stage and the hair-like spore columns of the III or mature stage of this fungus have been found on the cultivated yellow-flowering or Missouri currant in this state. This host is especially subject to the disease, being almost as much so as the black currant. The collections were made in each of the years 1916 to 1919. They were chiefly from the northern and eastern part of the state, in quite a number of different localities, at least twelve being recorded in 1916.

Currant, Red, *Ribes vulgare.*

BLISTER RUST, *Cronartium ribicola* Fisch. We have not reported the white pine blister rust on this host except incidentally in our 1915 Report, p. 423, where we noted that Spaulding found specimens near Meriden. There were only a few sori on abandoned bushes in the Middletown Water Company's Plantation at the Digby reservoir. Since then many other collections have been made in the state, the rust being common on abandoned or escaped currants in the woods in the vicinity of Norfolk and especially near the woodlands where the *Peridermium* stage on white pines is found. In 1916 thirty-eight collections were reported in twenty-six different towns or localities, and in 1917 an

even larger number of collections were made but mostly in the same localities. Since then the collections have been made each year but not to such an extent as the search has not been so thorough. While these localities reported are fairly well scattered over the state they represent chiefly the northern and eastern sections.

Mottled Chlorosis. We have occasionally seen isolated branches on currants where the leaves showed a conspicuous yellow mottling over the whole or part of the leaves. This may show as numerous small bands following the veins and enclosing equal angular areas of normal green tissue. The cause of this chlorosis we do not now know. Similar leaves have been seen on isolated branches of apple trees. Injury to the leaves in their very young state by sucking insects or by frost has been suggested as a possible cause.

Dewberry, *Rubus* sps.

ORANGE RUST, *Caeoma nitens* Schw. Germination tests seem to indicate that all specimens of this rust on wild species of *Rubus canadensis* in Connecticut belong to the short cycled form. We have not yet found this rust on cultivated dewberries. See Raspberry, in this Report, for further details.

Fir, Douglas, *Pseudotsuga mucronata.*

GREY MOLD, *Botrytis cinerea* Pers. We are indebted to Mr. F. A. Bartlett for calling to our attention in August, 1919, this disease on Douglas Fir at the Rockefeller Estate, Greenwich. The fungus kills the young shoots of the season's growth, and develops a more or less conspicuous growth of the characteristic conidial stage on the dead tissues. The fungus occurs on a variety of herbaceous plants as a parasite under moist conditions.

This fungus has been also reported as causing injury to Douglas Fir in Germany by Tubeuf (Diseases of Plants: 269. Eng. ed.) who named it *Botrytis Douglasii* but Smith (Bot. Gaz. 29: 403. 1900.) considered it the species mentioned here, of which *B. vulgaris* is also given by him as a synonym. Some authors (See Duggar's Fungous Dis. Plants: 196.) consider *B. cinerea* as merely the conidial stage of *Sclerotinia Fuckeliana* DeBy.

Gooseberry, *Ribes* sps.

Blister Rust, *Cronartium ribicola* Fisch. The blister rust, both in its II and III stages, has been collected several times on cultivated gooseberries in the state during the last few years. However it does not occur so commonly or abundantly on this host as on the red currant, and much less so than on the yellow or black currants. Even when these other plants alongside of it are abundantly infected, it may escape infection entirely. This is probably only a specific characteristic of the gooseberries cultivated here, as certain species of native gooseberries, and others used in our infection experiments indoors, are easily and abundantly infected. Of the five collections made on cultivated gooseberries in 1916 and 1917, all were on plants in the northern or eastern part of the state.

Grape, *Vitis* sps.

Rot, *Pythium hydnosporum* (Mont.) Schroet. In August, 1919, E. V. Parr of Clinton sent us grapes that were badly diseased. This was chiefly due to the black rot fungus which was very prominent that year, though some injury was also caused by the grape berry moth. Other fungi present apparently followed as saprophytes, of which the *Pythium* named above was the most conspicuous. It is a fungus that is not reported, at least prominently, in American literature. We have seen it occasionally developed in rotten potato tubers, the original host, following injury by *Phytophthora infestans*, and have also found it on pea roots (kept in water) injured by the *Phytophthora cactorum* mentioned in this Report. On these rotting grapes, however, we found it developed more prominently than ever before.

The oospores in certain grapes were very abundant, in some being produced within the pycnia of the black rot as if belonging there naturally. They were also found in the grape tissues and even in the bodies of the larvae infesting them! The oogonia (see Plate LVI, 9) are very striking because of their fairly numerous conspicuous spines. These reach out to 2-5μ beyond the oogonial wall and are often quite sharply pointed but with age they may become blunter and less conspicuous. The smooth spherical oospore is often so closely enveloped by the oogonium

that this resembles one of its coats. With age the oogonia are tinted and, including the spines, measure from 20-27μ in diameter, while the oospores vary from 15-20μ with their thick wall from 2.5-3.5μ. No other stages were seen by us and according to Winter, who calls it *Pythium artotrogus,* none have been found. It is now placed under the sub-genus *Artotrogus* (under which it was originally described by Montaigne) because of the spiny oogonia.

Lightning Injury. In July, 1918, we had called to our attention at Marlborough, lightning injury of grapes. According to the owner, Mr. d'Esopo of Hartford, a year or two previous lightning had struck the two wire trellis along which the Clinton variety of grapes was trained. Within a day or two all the branches that were attached to the wires were dead. However, the main stem was not killed and new runners were quickly developed from this, so that at the time we saw them they were as vigorous as ever. Prof. Hollister, who was with us at the time, stated that he had seen similar injury to grapes at Bolton Notch.

Smoke Injury. We were called in September 1919 to examine serious smoke injury to a variety of plants in the suburbs of New Haven. There was a difference of opinion as to the cause of the injury, some claiming that it came from an aluminium factory and others from a brick kiln After our examination of the vegetation in the vicinity of each, we had no hesitancy in deciding that the brick kiln was the responsible agent. The kiln was situated along the railroad, and the smoke had been carried in a west southwestern direction until it struck against the hillside of East Rock Park. From the slopes of this going toward the kiln, one could trace all the way in a direct line, damage to a variety of trees, vines and herbs.

In the park gray birch, beech and hornbeam were the trees most injured. Hemlock, hickory and maples here showed the least injury. However, in 1910 (Rep. 1909-10: 722.) we saw serious injury to conifers, especially young spruce, in this same park from another brick kiln. Maple and elm trees, midway of the park and the kiln, showed the trouble more or less prominently according to their situation. Part of the injury to the maples, however, may have been due to sun scorch as we are

unable to tell these troubles apart from the appearance of the leaves. Corn, tomatoes and some trees and weeds near the kiln were also injured. Grapes in a number of the yards midway showed the trouble as conspicuously as any of the plants. Their leaves were badly scorched and some of the young twigs suffered injury at their base. The ripening fruit was insipid and was dropping considerably. The few peach trees seen did not seem to be injured, which agrees with Stone's statement, *loc. cit.*, that this tree, with black locust and *Ailanthus*, is more immune than most trees.

As we have heard of injury to vegetation from at least three brick kilns in this state, it might be well to give here the conditions under which, as we understand them, this damage occurs.

In the first place the injury is chiefly due to the sulphur dioxide in the smoke that comes from coal in the fires and particularly from the coal dust mixed with the bricks to help burn them. As these become red hot it is necessary at a certain time in the firing to lift the board covers of the sheds to avoid fire and let out the heat and smoke. If this takes place on a wet or muggy day and the smoke is driven toward the ground and comes in contact with the damp foliage, a burn results, probably due to the formation of sulphurous or sulphuric acid. If the day is fair and the smoke ascends no damage results. So only occasionally, when all conditions are right, does injury to vegetation follow. Smoke injury is not always due to sulphur dioxide, but other gases and sedimentary deposits sometimes cause injury in specific cases.

In our Report for 1908 we mention briefly smoke injury to asparagus from a brick kiln and in the present one describe injury to apple (*q. v.*) by smoke from a bronze factory. Smelters, particularly in the western United States, cause such great injury that much special investigation has been made in recent years by botanists and others. Hedgecock (Torr. 12: 25-30. 1912. Journ. Wash. Acad. Sci. 4: 70-1. 1914.) has briefly described such injury in Montana and Tennessee. Bakke (Ia. Agr. Exp. Sta. Bull. 145: 383-409. 1913.) gives a more detailed account, with references to literature, upon "The Effect of City Smoke on Vegetation," while Stone (Mass. Agr. Exp. Sta. Bull. 170: 228-32. 1916.) treats of the effect of atmospheric gases on shade trees, in a popular manner.

Winter Injury. The d'Esopo vineyard, previously mentioned under Lightning Injury, is situated on a high ridge in Marlborough and is the largest vineyard in the state, consisting of about one hundred acres. For some years the Italians have been gradually going into growing grapes and this fruit is therefore becoming more prominent while the peach is becoming less so. As comparatively few grapes have been grown here commercially, except in a small way, the troubles of the vine require more notice than has been given them in the past.

We wish to call attention here to a very serious trouble that developed in this vineyard, chiefly on Concords, which with Professor Hollister of Storrs, we were asked to investigate. It was first noticed in the early summer of 1917 when the vines in some cases produced a scanty or sickly foliage and in a few cases died outright. Mr. d'Esopo thought some unknown disease was at work, especially as in 1918 the trouble became more conspicuous. Our examination, made July 18, soon convinced us that the trouble was entirely winter injury, due in part to a lack of snow mulch in 1916-17, but more particularly to the very severe winter of 1917-18. The vines most injured were on a ridge. Some of these were dead, others dying, or with more or less scanty foliage, and some apparently in fair shape. We found the wood of the sickly vines to be sound, but an examination of the roots showed these were injured and in some cases, especially those nearest the surface of the ground, partly or entirely dead. The condition of the foliage above ground corresponded so closely to the condition of the roots beneath that one could not doubt that it resulted from this diseased condition of the roots. There was nothing on the roots to indicate a parasite as the cause of their death, one peculiar saprophytic hyphomycete on certain dead roots being the only fungus seen.

There was no question that winter injury was the cause since complaints of winter injury to fruit trees from these two winters, especially the last, had been greater than for many years. Many peach trees on this farm had been killed. Then, too, the exposed high elevation of the grapes had been favorable for such injury and we had another complaint from the neighborhood of Colchester of similar injury under such conditions although the grapes in both localities had received good attention.

Most persons are likely to overlook winter as the cause of much injury to grapes since it often does not become manifest until early summer, after the foliage has been put forth, when the leaves die quickly under the hot sun or dry weather conditions. The winter is much harder on the roots than on the vines above ground. Often the roots are dead or badly injured when the vines and buds are uninjured, but while the buds may develop they cannot live, or only a portion can live if the roots are not too severely injured. In the latter case good cultivation and fertilization early in the season to stimulate new root growth is desirable. Snow or other mulch of course is helpful in preventing the trouble. Wet spots and shallow soil are to be avoided as being more likely to favor winter injury. Selection of hardy varieties, where possible, is also to be taken into consideration although the Concord, more or less subject to injury, is the most common variety grown.

Hickory, *Carya* sps.

Connate Fomes, *Fomes connatus* (Weinm.) Gillet. Plate XXXVIII, b. This fungus is called *Fomes populinus* by Murrill. The specimen shown here was collected Nov. 25, 1918, on a living hickory tree in the woods between New Haven and Milford. The bracketed pilei in this cluster were much larger than we have seen them on the maple, the ordinary host in this state, being 4 by 4 by 8 inches. The upper surface of the pileus is whitish, with age becoming blackish or greenish with algal growth behind. The under or fruiting surface has more of a flesh color, the rather small and thin pores often having a satiny lustre. The pilei are irregular, with small shelves often growing into the larger. The stratified pores, characteristic of the genus, are evident but often irregularly placed.

This species differs from most of the *Fomes* found in this state by the less woody and more corky pileus especially its context. Murrill (Northern Polypores: 47.) says: "Rather common throughout on living trunks of maple and certain other deciduous trees, causing decay."

Witches' Broom. Plate XXXVIII, c. This trouble of *Carya ovata* was first called to our attention in 1917 by Mr. E. B. Harger of Oxford, Conn., and we have seen specimens from his trees each

year since. Swollen places show on the branches and from these several secondary branches are formed giving the witches' broom effect. The leaves drop off prematurely, often leaving the petioles still attached to the limbs. The morbid growth eventually dies, killing the parts beyond. Mr. Harger has observed about a dozen hickory trees so affected on his place and thinks the trouble is spreading slowly although not many of the branches on a tree are yet involved.

We were unable to find any indications that this was an insect injury and very little evidence that it was caused by a fungus. No fruiting stages have yet been seen on any of the branches. Mr. Stoddard, in examining the wood microscopically, found a little evidence of mycelium in one specimen but was unable to obtain cultures of a fungus from the tissues of the morbid growths. Of course it is possible this trouble is merely a stag-head growth developed through winter injury of the terminal bud or tip of the twigs.

Honeysuckle, Hall's, *Lonicera japonica* var. *Halliana.*

Crown Gall, *Pseudomonas tumefaciens* (Sm. & Towns.) Stev. This bacterial disease was sent us on the above host, new to the state, from the Elm City Nursery in June, 1918. It was not causing any great damage, showing as small galls on plants in storage.

Horsechestnut, *Aesculus Hippocastanum.*

Anthracnose, *Glomerella cingulata* (Ston.) Sp. & v.S. Plate XXXIX, a. Specimens of this disease of horsechestnut were sent us about the middle of August, 1917, by Mr. C. F. Crosson and a short time later we examined the tree from which they came. The tree was in the yard of Mr. George Wilcox at Meriden. Many of the leaves showed a bad scorch-like injury and were dropping prematurely. Often only part of the leaflets or a portion of the blade of a single one showed the reddish-brown injury, the rest remaining the usual green color, as shown in the photograph reproduced here. An examination of the tissues of the blades, the midribs and the petioles revealed the presence of both the *Gloeosporium* and asco stage of the above fungus.

So far as we know this is a new, or at least an unusual, host

for this fungus as it is not reported in Saccardo's or Farlow & Seymour's Host Index or by Shear and Wood in their bulletin on Glomerella. The tree was in a sickly condition, other than from the action of this fungus on the leaves, apparently due to winter injury. Whether or not this weakened condition of the tree influenced the appearance of the anthracnose on the leaves we do not know, but there was no doubt that it was occurring there as an active parasite.

RED CANKER, *Tubercularia vulgaris* Tode. Plate XXXIX, b. This was collected on the branches of the winter injured tree mentioned above. The fruiting stage breaks through the bark as numerous, small, firm, pinkish pustules. It seems to be at most a weak parasite and is the conidial stage of *Nectria cinnabarina* (Tode) Fr., with which it is often associated but was not in these specimens.

Winter Injury. Besides the above horsechestnut tree, which showed dead branches and some winter cankers due to the unusual exposure on a terrace to the western sun, we had specimens sent us from Wallingford, by Mr. C. H. Brown, of a rather unusual winter injury. The leaves on certain branches from this tree developed later and were much smaller than those of the rest of the tree. On cutting those twigs lengthwise, the pith in the previous year's growth was found to be, especially at the nodes, turning a reddish-brown color. This winter injury no doubt had been sufficient to interfere somewhat with the transference of the starch, as it was present here but not in the normally white pith, with the result that while the leaves were put forth they did not reach their full size through lack of sufficient food for normal growth.

Hydrangea, *Hydrangea paniculata* var. *grandiflora.*

Chlorosis. We know of no variety of this cultivated plant that is variegated. In a yard near the Station is a plant certain of the leaves of which showed a whitish mottling, in the fall of 1916. Usually these small spots ran more or less together and were situated in the vicinity of the larger ribs or at the margin of the leaves. The mottling was quite varied in pattern, in one case forming a nearly complete, narrow, banded circle at the apex of a leaf. In some respects the trouble appeared like

insect injury to the leaves when very young which prevented chlorophyll formation at these spots.

Kohlrabi, *Brassica oleracea* var. *caulo-rapa.*

CLUB ROOT, *Plasmodiophora Brassicae* Wor. Plate XXXIX, c. This slime mold disease of cruciferous plants, showing on the roots as irregular knobs or gall-like growths that eventually rot off, has previously been reported by us on Brussels sprouts, cabbage and turnips (both yellow and white) and is recorded here on radish, *q. v.* It was found on the roots of kohlrabi sent the Station in June, 1918. Club root was unusually common that year being most frequently found on cabbage, the only host on which we have found it causing very much damage in the state so far. Badly infected cabbage plants fail to grow, in many cases turning yellow and dying prematurely, or at best making small heads. While the germs become established in the soil and infect plants each year, certain seasons seem to favor their development more than others. The season of 1918 was much more favorable than that of 1920.

Larkspur, *Delphinium* sp.

Fasciation. A specimen showing fasciation of a single fruiting stem of a cultivated larkspur from the garden of Mrs. E. D. Driesbach, Whitneyville, was collected by Mr. Stoddard in July, 1919. The flattened two-foot stem in this case was about half an inch wide, or twice its normal diameter for the entire length. The upper half of the stem was occupied by the seed pods and had a half curl part way up. The top was forked for a short distance but the tips were not coiled. See Asparagus.

Lettuce, *Lactuca sativa.*

BLADDERY PEZIZA, *Peziza vesiculosa* Bull. Specimens of this fungus were sent us in May, 1918, by Mr. Gordon J. Gale, Garden Supervisor of Bridgeport, who found them in a cold frame of lettuce. They did no harm, except from crowding the plants, as the fungus is a saprophyte developing only on the humus in the soil. This is one of the cup fungi, occurring in thick clusters of semi-globose cups (often flattened by pressure) which are closed at first but later open by an incurved broad mouth. The sessile cups are an inch or two in diameter.

Concerning the fruiting receptacles Hard (Mushrooms, Edible and Otherwise: 508. 1908.) says: "They are found on dung hills, hot-beds or wherever the ground has been strongly fertilized and contains the necessary moisture. This is an interesting plant and often found in large numbers."

Maple, *Acer* sps.

CONNATE FOMES, *Fomes connatus* (Weinm.) Gillet. We have seen this species several times on maples, especially on living red maples at both Woodbridge and Union. It is more or less of a parasite, chiefly causing decay of the heart wood. Under Hickory it is described more in detail.

Mountain Ash, *Pyrus americana.*

RUST, *Roestelia cornuta* (Pers.) Fr. So far we have found this rust only at Norfolk, Conn. We remember seeing specimens several years ago on American mountain ash trees in the golf grounds there and in June, 1919, collected specimens of the spermagonial stage on the same host at the edge of woods in the same general vicinity. Very near these small trees, whose leaves were rather abundantly infected, we found the III or mature stage on *Juniperus communis.* On the mountain ash the fungus makes conspicuous yellow spots, showing on both sides of the leaves, with the spermagonia quite evident on the upper and the aecia in time appearing on the lower. This fungus is a northern species, apparently, specimens having been sent us from both Massachusetts and Maine where it seems to be more common than in Connecticut.

Farlow (Host Index: 199.) also gives *Aecidium globosum* on this species of mountain ash and Kern (Bull. N. Y. Bot. Gard. 7: 434. 1911.), while he lists six species on Sorbus, gives only these two on *Pyrus* (*Sorbus*) *americana.* Concerning the III stage, *Gymnosporangium cornutum* (Pers.) Arth., Arthur (Myc. 1: 240. 1909.) says: "Telia on branches of *Juniperus Sibirica* Burgsd. were collected May 19, 1908, by Mr. F. D. Kern and Mr. E. Bethel, at Palmer Lake, Colo., and sown May 23, on *Sorbus americana,* giving an abundance of pycnia June 1, followed by numerous aecia. * * * Although the horn-like aecia of this species are common and often collected, this is the first time that the telia have been found in America." Thaxter

(Farlow Bibl. Index: 36. 1905.) however, seems to think the proper name of the mature stage is *Gymnosporangium conicum*, as he says: "Since what is believed to be the true *Gymnosporangium conicum* D. C. occurs in New England and northward on *Juniperus communis*, the citations of *Aecidium cornutum* on *Pirus americana* in those regions probably refer to the true *Aecidium cornutum* of Europe."

Musk Melon, *Cucumis Melo*.

ANGULAR LEAF SPOT, *Bacterium lachrymans* Sm. & Bryan. Although this bacterium was described originally on cucumbers (*q. v.*) there seems to be no reason for doubting that it causes the similar disease on musk melons mentioned by us in our 1903 and 1904 Reports.

Oak, *Quercus* sps.

PINK ROT, *Cephalothecium roseum* Cda. This fungus was brought us in July, 1916, by the entomological inspectors, on specimens of *Quercus rubra* recently imported by a nursery from Holland. They had just been transplanted and the stems were dying, a growth of the above fungus developing on them. We have little doubt that the trees were injured by long continued or poor storage on ship-board, perhaps developing scald from improper watering and heating, and that this fungus came as a result and not as the cause of injury. During the war, shipping conditions were very bad and many shiploads of plants were lost or greatly injured because of slow delivery.

SULPHURY POLYPORE, *Polyporus sulphureus* (Bull.) Fr. Plate XXXIX, d. Large fruiting clusters of this fungus were found on a living oak shade tree at the Barnes Nursery, Yalesville, in September, 1917. The fungus was doing considerable injury to the tree, possibly having got a start through winter injury of the bark. It is one of the larger and more attractive polypores. When young the fruiting brackets are quite compact, as shown in the illustration, and are fleshy and moist, but with age they develop into more flattened, shelf-like, overlapping pilei that in drying become corky and brittle but are not so durable as the real woody kinds. The upper surface has a reddish or orange color, and the lower, poroid, fruiting surface a decided sulphur yellow. The flesh is white. It is not uncommon as a saprophyte.

Cooke (Fungoid Pests Cult. Plants: 208: 1906.) says of it: "This large and attractive looking polypore is a wound parasite on several trees such as oak, alder, willow, poplar, and even pear and apple, as well as larch." Von Schrenk and Spaulding (Bur. Pl. Ind. Bull. 149: 37. 1909.) write, "It is widely distributed throughout the United States and Canada and in most of the forest regions of Europe, where it is regarded as a destructive parasite, both on deciduous trees and conifers."

WHITE HEART ROTS, *Fomes igniarius* (L.) Gill. and *F. Everhartii* (E. & G.) v. Schr. & Spauld. By European authors the first of these large, perennial, woody fungi has been given the common names of False-tinder fungus or Rusty-hoof Polyporus. It is not uncommon in this section of the country on various hard woods, but so far in this state we have seen it only upon oak and apple, *q. v.* As we have observed this fungus, it first develops as rounded, smooth, ferruginous knobs on the trunks. In time these growths show a differentiation into upper and lower surfaces, the upper becoming greyish in color and the lower ferruginous surface developing the small fruiting pores; the shape now has become somewhat ungulate or even more flattened. With age the upper surface turns black and is somewhat zonate and cracked but still with a ferruginous, smooth, obtuse margin separating it from the poroid surface. The spores are said to be hyaline but we have failed to find them on the specimens we have examined. The stuffed whitish tubes also are somewhat characteristic.

Von Schrenk and Spaulding (U. S. Bur. Pl. Ind. Bull. 149: 25-37. 1909.) give a comprehensive description of the fungus and its injuries in their bulletin on "Diseases of Deciduous Forest Trees." It is considered quite a serious wood rotting fungus, causing the heart wood especially to become broken up into a whitish punk, hence the common name of the disease. It also injures the living wood and bark slowly. The fungus not only renders the wood unfit for timber but weakens the trees so that they are more easily blown over. It is said to gain entrance through wounds and often fruits near its point of entrance. We noticed it for several years on a street tree of *Quercus velutina* in New Haven. Each year the fruiting bodies were cut off but reappeared, in time, with the disease slowly ex-

tending in the bark until finally the tree was cut down because of the injury.

The second species was originally described by Ellis and Galloway (Journn. Mys. 5: 141. 1889.) as *Mucronoporus Everhartii* and has since been placed by Murrill under both *Pyropolyporus* and *Fulvifomes,* but in the opinion of the writer belongs better under the more comprehensive genus *Fomes,* characterized by layers of fruiting tubes formed in superimposed strata each year. This species is much like the former in appearance and is sometimes mistaken for it but the upper surface becomes more cracked and rougher with age and the strata of tubes are more reddish without much evidence of the white stuffed appearance and easily yield an abundance of ferruginous spores. Von Schrenk and Spaulding, *loc. cit.* p. 48, state that the action on its host is much the same as that of the other species. We have found it only once in this state, on a living oak near Lake Congamond in June, 1916.

Onion, *Allium Cepa.*

During the last five or six years some attention has been given by us to the onions which are grown for seed in this state. This seed-growing has been quite an industry in the past but the great uncertainty of a crop, due largely to the so-called "blast," has discouraged most farmers from growing onions in recent years. In our study of the blast we have noted various troubles and abnormalities, mostly of a non-parasitic nature, which we briefly describe here. For Blast see Plate XLII, a.

RUST, *Puccinia Porri* (Sow.) Wint. We reported (Conn. Agr. Exp. Sta. Rep. 1915: 438. 1916.) the II stage of this fungus, found on Ægyptian perennial onions at Storrs, in 1914. We have since collected it on the same plants several times but the collection on Nov. 17, 1917, was the only one where we found the III stage, thus completely establishing the identity of the rust. Apparently this mature stage develops rather late.

YELLOW LEG, *Fusarium* and *bacterial* rots of bulbs, etc. This trouble usually shows when the onions are fully grown, but not matured, by occasional stalks turning yellow below and finally dying before fully maturing their seed. Such stalks are easily pulled from the ground, as the roots have been largely rotted off.

Generally *Fusarium* or bacteria are the cause of this rot and these may come from the old bulbs, possibly developing there largely as saprophytes. Damp weather and poor bulbs favor the trouble.

Bastard Blossom. Plate XL, a. This is a common name applied by growers to occasional abnormal heads that appear in the field, the appearance of which is well shown in the illustration where two such heads are contrasted with the central normal one. These heads have the individual pedicels more elongated, so the flowers spread out in a larger laxer bunch. Growers complain that little or no seed is developed, so they pull them up when seen, but whether the seed that is produced tends to form similar plants we do not know. The reason little seed is produced is because the pistils are often changed into foliacious structures. Sometimes the heads fail to form blossoms at all, but in their place form numerous slender stem-like growths from little bulbils.

Bulblet Head. Plate XL, b. Occasionally the plants, instead of producing a blossom cluster at the end of the stalk, form a bunch of bulblets in the same place, as is often seen in wild species and some cultivated varieties. Rarely we have found specimens like that shown in the illustration, where after these bulblets were started the stem continued on above and also formed a smaller flower cluster. The specimen figured here also shows another trouble which we call "Goose Neck."

Double Flower Head. Plate XL, c. Occasionally instead of a single flower cluster on the end of the stem there may be two, a lateral one below the other. Usually these are about the same size and but a short distance apart, though we have also found specimens where the lower one was much farther down the stem and quite small.

Elongated Spathe. Plate XLI, b. Normally the flower head is enclosed when young by a small spathe that later becomes ruptured and withers up at the side as a sort of bract. Occasionally, however, it is more permanent and pretentious, continuing as a pointed extension of the stem, which the blossom finally forces to one side, as shown in the illustration.

Goose Neck. Plate XLI, a. This is a term we have coined for those not infrequent crooks in the stems that develop all

the way from a slight bend to a completely coiled turn or even a turn and a half, as shown in one specimen in the plate. We cannot be sure of the cause of these but suspect that during rapid growth the stem is sometime bent to one side, from one cause or another, and this produces turgor that results in more rapid growth on the opposite side and the resulting curvature. Possibly in pushing through the bulbs the stem is sometimes caught at the tip and before this is released the stalk has made a bending exit. The natural tendency, after the bending has become prominent, is for the tip to again grow upwards, hence many half turns, bends, etc.

Hail Injury. Plate XLI, c. We saw rather severe injury to a field of Southport White Globe seed onions in Milford, caused by a hail storm on July 27, 1917. As usual there soon showed on the side of the stalks from which the storm came the characteristic white spots or marks that we have found with hail injury to tobacco, *q. v.* Corn in an adjacent field also showed a little of a similar injury. Plate XLI, c, shows three hail-injured onion stalks, two showing the injured sides exposed to the hail and the other with the uninjured side protected from it.

White Ring. Plate XLII, b. This trouble shows as narrow white rings or cracks extending more or less completely around the stem. They apparently start as a small break in the epidermis which extends crosswise around the stem but whether gradually or suddenly we do not know. These rings may be single or several parallel to each other and are always found somewhat above the bulge on the lower part of the stem. If they extend deeply into the tissues the stem often breaks off at one of them.

At first we thought that they were the result of insect injury but finally decided that they are growth cracks. The epidermis of the stem is very thick and the stem makes a rapid growth of three or four feet in a few weeks at most. This stretches the epidermis greatly, especially longitudinally, with the result, in our opinion, that cracks develop at the place of greatest strain which appears to be above the bulge on the stems.

Under the designation of "Crack Neck" Chapman has recently described (Phytopath. 9: 532-4. 1919.) and illustrated a trouble of chrysanthemums very similar to this. The causes he states as follows: "(1) Very little transpiration takes place as a re-

sult of the low air temperature and the high humidity, and (2) the soil temperature remaining practically stationary, the soil having been previously well supplied with moisture; and the roots functioning normally in so far as the absorption of water and solutes was concerned. These and similar conditions always bring about abnormal cell relations and in consequence an excessive turgor is brought about in some of the cells with no normal means of regulation, such as occurs when the plants are transpiring freely, and as a result some of the tissues must give way to permit of a return to the normal condition."

Pea, *Pisum sativum.*

Root Rot, *Phytophthora cactorum* (Cohn & Leb.) Schroet. Early in July, 1919, Mr. A. N. Farnham, a large market gardener of Westville, sent to our office samples of pea vines that were being killed by some unknown agent. The vines at this time were in their prime, the first picking not yet having been made. The vines eventually turned yellow and wilted down, so that, except for the one or two small early pickings, there was practically no crop in a field of several acres. A visit to the field showed that the trouble started as a root rot, but in time the stem also rotted somewhat below and both became invaded by bacteria, nematodes, etc. Other fields in the vicinity showed the same trouble, which had little or nothing to do with the manner of fertilization or rotation. Afterward complaints came in from growers in Milford, Waterbury, Bloomfield and Winsted. The trouble was also seen in the writer's and in the Station's garden. Very similar troubles have been caused in previous years by both a *Fusarium* and a *Rhizoctonia* fungus. While these may have been the cause of the trouble on some vines this year, we could not find them generally present, and so were inclined to look elsewhere for the chief cause.

With many of the specimens it was difficult to find, on ordinary examination, any fungus apparently guilty of the trouble. Continued search, coupled with sections of the tissues, however, usually revealed the presence of oospores of a phycomycetous fungus more or less prominent in certain of the tissues. This was especially true of the Farnham field where we had the best opportunity for studying the trouble. We finally came to the conclusion that this fungus was at least the original agent in

starting the trouble and that its development might be rather local in the underground parts. It was too late to study the disease in its beginning, but it did not seem to act like the ordinary dampening off caused by *Pythium de Baryanum,* especially since no complaints of a poor stand were received. We found the oospores, occasionally with attached antheridia, chiefly in the outermost tissues which also contained the prominent intercellular mycelium that gave rise to them. No signs of any other stage was found, and apparently the mycelium in later stages of the rot did not develop so prominently, being crowded out by other rot agents.

The oogonia were chiefly hyaline but with age in the old specimens became somewhat tinted yellowish-red and the wall (1-2μ thick) wrinkled. They varied from 24-36μ but were chiefly 27-33μ in diameter. The thick walled (2-4μ) smooth oospores varied from 20-30μ but were chiefly 22-27μ in diameter, and from oval to chiefly subspherical in shape. The oval shape was apparently due to pressure when formed within the plant cells. When we first tried to identify this fungus from the oospores found in the tissues, we were uncertain whether it was a *Pythium* or a *Phytophthora.* Naturally *Pythium deBaryanum* suggested itself, but the fungus failed to form any external mycelium when specimens were placed in water. The oogonia and oospores of *P. deBaryanum* as seen by us on Spinach (*q. v.*), also in a culture received from Washington and as given by Fischer (Die Pilze 1^4: 404. oogonia, 21-24μ; oospores 15-18μ), were considerably smaller than those found in the pea roots. Furthermore Fischer states that Hesse failed to infect *Pisum* with *Pythium deBaryanum* in his infection experiments. Atkinson (Corn. Agr. Exp. Sta. Bull. 94: 245. 1895.) gives an extended description of *Pythium deBaryanum* that agrees with these others but not well with our pea fungus. On the other hand Jones (Phytoph. 10: 67. Ja. 1920.) has recently published a note on pea blight in Wisconsin, etc., occurring in 1919, that he attributes in part to "*Pythium* (probably *deBaryanum*)." Various references exist in literature (Tubeuf and Smith Dis. Plants, p. 117; Zeitschr. Pflanzenkr. 2: 253.) to a *Pythium Sadebeckianum,* described by Wittmack from Germany in 1892, as causing serious root rot of peas and lupins. We have not seen the original reference and have not been able to find any

description of the fungus giving measurements of the oogonia and oospores. It is possible that this is the fungus we have found and that it is quite distinct from *P. deBaryanum.*

On the other hand the fact that Hesse failed to infect peas with *P. de Baryanum,* and the absence of any definite sporangia, so far as we could determine, and the agreement in size of the oospores and oogonia with *Phytophthora cactorum,* has led us to conclude that this latter is the fungus that we have been dealing with. Our preliminary infection experiments of peas in Petrie dishes and crocks with *P. cactorum* from Pear also indicated that under certain conditions infection of the seeds and roots may take place, though apparently not so abundantly or seriously as similar infections with *Pythium deBaryanum.* Apparently moisture conditions and the stage of the cultures are important factors in the results.

Phytophthora cactorum seems to be a soil fungus and is accused of causing root and stem rots in a great variety of plants in Europe. It was present to an unusual degree in Connecticut in 1919, as shown by rotting pears and apples on the ground. The year was very moist and favored this unusual development. The injury to corn (*q. v.*) already mentioned, and the fact that in 1907 we found similar oospores in the roots of rotting sweet peas, also help us to the conclusion that in very wet situations or moist years this fungus may be responsible for more or less obscure root rots on a wider range of hosts in this country than have yet been reported. It is very desirable that cultures from various plants be obtained for definite comparisons and inoculation experiments. It is not easy, however, to obtain cultures under conditions of rot as produced on the pea vines.

In comparing the oogonia and oospores of these fungi in cultures with those found in the rotting tissues in nature, it is well to remember that under the latter conditions, especially in old dried specimens, one is liable to find the walls more deeply tinted and thicker, and the oogonial walls often wrinkled or folded. These variations might lead one to suppose they are specific differences, when they are merely due to the different conditions under which the spores are produced. In Plate LVI, Dr. McCormick has made drawings of different species of *Pythium* and *Phytophthora cactorum,* as produced in artificial cultures and as found on various hosts in nature, in which we

have tried to bring out specific differences and the environmental variations in the same species.

For further discussion of *Phytophthora* and *Pythium* rots in this Report, look under the following: Apple, Celery, Corn, Grape, Pear, Sweet Pea and Spinach.

ROOT ROT, *Fusarium* sp. Specimens of garden peas showing this root and stem rot were first received from C. A. Weatherby of East Hartford in July, 1917, and in June, 1918, others were sent by J. H. Taylor of Middletown. The general symptons are very similar to those mentioned in the preceding trouble. The plants usually attain fair size and may even start to blossom when they turn yellow and wither away. An investigation shows that the base of the stem and roots have been rotted away so that the vines are easily pulled from the ground. Microscopical examination of the tissues reveals the mycelium of a *Fusarium* rather abundant and extending up into the healthy tissues. Some microconidia may be found, but if the specimens are placed in a moist chamber usually an abundance of a white or pinkish mycelium appears over the tissues with both macro- and microconidia. Besides the *Phytophthora* and *Fusarium* mentioned here, *Rhizoctonia* also causes a similar trouble. Wet weather plays a very prominent part in the development of all these fungi. Care in the use of manure, rotation and frequent cultivation to keep the top soil dry, help to control these troubles.

Pea Shrub, *Lespedeza Sieboldi.*

Fasciation. This abnormality was called to our attention by Dr. Britton who, while inspecting the Steven Hoyt & Sons' Nursery at New Canaan, in the latter part of August, 1917, found a couple of stems of a plant of this Japanese shrub-like herb that were very abnormally flattened. These or similar stems were seen at the same place in May by Mr. Zappe. They were at least 18 inches in length and where broken off were still flattened so that they may have formed quite an extended flattened stem as the plant, which grows in bunches from the ground, sometimes reaches a length of six feet. Like other fasciation we have seen, the leaves were scattered apparently irregularly over the stem and the top was recurved or coiled for a couple of turns. One specimen had the usual bifurcated coiled tips of approximately the same size, while the other had a much smaller

side branch. In each case the two branches coiled to the same side. Under Asparagus in this Report, pp. 415-17, we call attention to the similar fasciation on that and other plants.

Peach, *Prunus Persica.*

DIE BACK, *Valsa leucostoma* (Pers.) Fr. Plate XLIII, a. This trouble was first called to our attention in 1917 by Mr. N. S. Platt who complained that it was causing serious injury to his orchard at West Haven. We have examined the orchard several times and have seen cankers of all sizes from small dead spots on the twigs to large cankers, on the main branches, several inches in diameter and the bark entirely gone. Often these develop at the base of a dead twig or branch and are much like winter injury cankers with which we believe the trouble to be closely connected. Mr. Platt, with more or less success, has tried to control the trouble by carefully cutting away these cankers each winter.

At first we thought the trouble might have some connection with the brown rot as the cankers much resemble those described by Jehle (Phytopath. 3: 105-10. 1913.). We failed, however, to isolate this fungus from the injured or dead tissue. After some failures we finally in 1918 succeeded rather uniformly in obtaining cultures of the *Cytospora* stage of the *Valsa* here named and later were able to find this conidial stage more or less abundantly on the infected branches. Rolfs (Mo. St. Fruit Exp. Sta. Bull 17: 1-101. 1910.) made an elaborate study of this trouble and its cause and came to the conclusion, partly through inoculation experiments, that this fungus was largely responsible for similar injury to peaches in Missouri.

Winter Injury. Plate XLIII, b, shows a neglected and winter injured peach orchard at East Wallingford. During the severe winter of 1917-18 many trees were killed or badly injured. Our experimental orchard at Yalesville, although most of the trees were severely hurt and some killed, was saved by vigorous pruning and liberal fertilization with sodium nitrate and has since made a splendid growth.

Pear, *Pyrus communis.*

DOWNY MILDEW ROT, *Phytophthora cactorum* (Cohn & Leb.) Schroet. Plate XLIV, a. We first found this fungus on pears

sent us the last of September, 1919, by A. B. Beers of Bridgeport. These pears had been picked and stored but when ripening started rotting apparently from the inside. This was a soft rot, the slightly discolored and diseased tissues easily separating from the healthy and forming darker or reddish-brown areas on the skin, with no signs of any spore stage, as shown in the illustration. The microscope revealed a non-septate, prominent, laxly branched mycelium, rich in oil-like drops, running between the cells. Sometimes there was a sidewise branch and occasionally two or three with one taking the place of the main branch and these varied in width from 3-9μ. There was no indication whatever of any spore stage. The mycelium was evidently of the same type as that found in the peculiar rotting of stored apples that were sent in for examination in 1918, brief mention of which has already been made under Apple in this Report.

Petrie dish cultures were easily obtained on oat agar and these produced a great abundance of oospores imbedded in the medium, but no aerial growth bearing conidia of any kind. We were not sure from this whether the fungus was a *Phytophthora* or a *Pythium*. However when the fungus was transferred with a bit of the medium to water in van Tieghem cells the typical conidia of *Phytophthora* were produced. A study of the cultures in both stages led us to the conclusion that the fungus was *Phytophthora cactorum* as described by Rosenbaum (Corn. Agr. Exp. Sta. Bull. 363:65-106. 1915.). Later cultures made at the same time and on the same medium, oat agar, from this pear fungus and from *Phytophthora cactorum* obtained from Wheztel in Nov., 1909 (host not given us but possibly ginseng,) grew exactly alike. The pear culture this time developed a little more prominent aerial growth, in which the conidial stage appeared. In cultures we found the oogonia varying from 24-36μ and the oospores from 21-32μ, but the average measurements were for the former 27-32μ and for the latter 24-28μ. The appearance of the oogonia and oospores is shown in Plate LVI, 4.

After determining the identity of the fungus we searched for it on the fallen fruit at the Station grounds. We were surprised to find on picking up the partially rotted pears showing no external fruiting stage that most of these contained mycelium of this fungus. An examination of the most suspicious apples on the ground in our orchard at Mt. Carmel also gave similar re-

sults. However, because of the advanced stage of the rots and their exposure to various animal and fungous invasions, we were not able to separate the *Phytophthora* in pure cultures from either the pears or apples. This experience leads us to believe that the fungus as a fruit rot is more common in this country than reports would indicate; by this we do not mean as a serious rot of fruit on the trees, but as an important rot of the fruit after it falls to the ground. It may be, however, that the unusual moist conditions of last summer were responsible for its development here. In no case on any of the fruit have we found any signs of a fruiting stage, so the identity of the fungus is easily overlooked.

We should not be surprised from our experience of 1919 with a variety of root rots, etc., if the fungus is responsible in wet years for more injuries than we now know. Besides the hosts we mention in this Report (apple, corn, peas, pear, sweet-pea, *q. v.*) Rosenbaum, in the reference already cited, gives the hosts for this fungus, reported chiefly from Europe, as follows: *Panax quinquefolium, Cereus giganteus, Melocactus nigrotomentosus, Phyllocactus, Sempervirum, Fagus, Acer, Pinus, Larix, Picea.*

An examination of the literature showed that this fungus already had been reported from this country on apples. Whetzel and Rosenbaum (Phytopath. 6:89. Fe. 1916.) reported it from New York state as found in July, 1915. These apples were on a tree in a garden, but were on branches near the ground. They also stated that it was isolated in the laboratory from apples purchased in the market and give references to its occurrence on both apples and pears in Europe. They report, too, that Osterwalder found both conidia and oospores on rotted fruit in Switzerland, which is different from our experience. Hesler (Bu. Pl. Ind. Pl. Dis. Sur. 2:172. 15S. 1918.) has since reported this trouble on other varieties of apples from New York. Very recently Güssow (Phytopath. 10:50. Ja. 1920.) reported the fungus on pears in Nova Scotia. So far as we have learned, our report is the first on this fruit in the United States. Under the title of "A Phytophthora Rot of Pears and Apples" Wormald (Ann. Appl. Biol. 6:89-100. D. 1919.) has very recently reported this same disease from England and given a detailed account of it including inoculation experiments and references to literature.

We have tried no inoculation experiments yet with the cultures obtained from the pear on either apples or pears. However from this same culture we had tried to infect 20 kinds of seedlings of herbaceous plants to prove its connection with the root rots that have been reported on certain of these. The results are partially given elsewhere under a few of these hosts.

Winter Injury Swellings. A trouble, similar to that shown on apple-twigs in Plate XXXV, b, was found on pears by the Stamford Quality Seed Store in March and by Miss Daisy Ineson from Ansonia in April, 1920. The swellings on the small twigs were usually at the end of the preceding year's growth and often at the base of a dead twig or where one had been. They were about twice the normal diameter of the twig and usually less than an inch long. Cross sections showed the swelling due to increase of pith cells and to a less extent of bark cells, with more or less irregular arrangement of tissues which were somewhat blackened.

The similarity of these enlargements to those described by Hedgecock on apples, *loc. cit.*, due to the crown gall organism, led us to believe at first that these had similar origin. Specimens were sent to Dr. Smith who said that they were not so caused and suggested winter injury. Inoculations made by Dr. McCormick on geranium stems with fragments of the injured tissues failed to produce any suspicious growth although similar inoculations made at the same time with cultures of the crown gall, *Pseudomonas*, were quite successful. This leads us to conclude that winter injury, killing the young growth of the year and slightly injuring that of the preceding year, caused the latter to make a morbid growth resulting in these enlargements.

Pine, *Pinus* spp.

Black Rot, *Sphaeropsis Malorum* Berk. This is a common fungus that causes more or less injury on apple twigs and leaves. We found it on the leaves of *Pinus austriaca,* collected at Black Point, Niantic, and mentioned later under winter injury of buds. It seemed there to be a saprophyte, or at best only a weak parasite, the trouble being originally due to winter injury. Hesler (Corn. Agr. Exp. Sta. Bull. 379:98. 1916.) gives white

pine as one of the hosts of this stage of the fungus whose mature form he finds to be *Physalospora Cydoniae* Arn.

Lightning Injury. Plate XLIV, b. In September, 1917, the writer with State Forester Filley inspected a white pine tree at Cornwall that had been struck by lightning about a month previously. It was a beautiful tall specimen standing by itself on a hillside. The bolt had made an evident crack in the bark from about two thirds the way up, where the branches began, to the ground forty feet below. Except for this splitting and a slight shattering of the bark, as shown in the photograph taken by Mr. Filley, and a few broken branches, there was no evident injury to the tree. Even the foliage on the broken-off branches was still green. The injury was therefore mechanical and not fatal to the cambium, etc., as in the cases of lightning injury to grape and tobacco mentioned elsewhere in this report.

Mice Girdle. We saw serious injury to a young plantation of white pine on a low spot in the American Optical Co.'s land at Union in 1918, and had previously received specimens from Watertown and elsewhere. During the winter of 1919-20, mice were also said to have seriously girdled Scotch pine in some plantations. See Mice Girdle under Apple.

Snow Bend. Plate XLIV, c. In the younger white pine plantations in the vicinity of Norfolk, after winters of heavy snow fall, the tops of the pines have been so long bent over from the weight of snow that the injury causes more or less permanent bends, as shown in the illustration.

Winter (Bark) Injury. Occasionally on the sunny side of white pine trees, there are seen more or less extended reddish brown areas, in strong contrast with the greenish color of the healthy bark. Cutting these with a knife shows that the tissues are dead, at least part way to the wood. As fruiting bodies are not seen in these areas and as cultures from their tissues have yielded no fungous growth, they appear to be merely local winter cankers. Often on older stems, where the tissues are changing from the smooth to the rough bark type, numerous small spots of similar color are seen but these do not usually reach in deep enough to cause particular injury.

Winter (Bud) Injury. Plate XLV, c. The writer, with Mr. Filley, during the summer of 1918 and twice since, made examina-

tions of injured Austrian pines near the shore in two places. The first called to our attention was on Black Point, near Niantic at the summer residence of Mr. A. H. Mosle; the second was at the residence of Dr. Winfield Ayres at Shippan Point, near Stamford. In both cases the trees were close to the shore and exposed to the severe winter storms. The trouble showed prominently the following summer when many of the tips of the branches failed to grow or their buds opened and developed only weakly, often dying later, as shown in the illustration. In late summer these injured and dead tips are in strong contrast with the healthy ones and are scattered more or less over the trees. The leaves at the tip of the Austrian pine branches form in winter a cup in which frozen spray could be easily held, thereby offering excellent opportunity for winter injury of the buds and adjacent tissues.

A search revealed no suspicious insects as possible cause, and the only fungus found, and that sparingly on the oldest injured buds, was the black rot, *Sphaeropsis Malorum*, previously mentioned. The Austrian pine does not seem quite hardy for such exposed places so that each winter some buds are injured but that of 1917-18, being exceptionally severe, caused an unusual amount of injury. One of the owners was inclined to think the trouble a contagious disease, but we have seen somewhat similar injury to unhardy pines in the state plantations at Rainbow. We have never found this trouble inland on Austrian pines, but specimens were sent us from Watch Hill, R. I., also on the Sound, in 1919, so we have no doubt as to its winter injury nature.

Witches' Brooms. We have seen two types of witches' brooms, illustrated here, on pines. On the white pine the broom took a bushy shape due to numerous small branches developing equal growth, with the leaves compactly massed together. (Plate XLVI, a.) The other, XLV, b, was on a branch of Scotch pine in a plantation at Union, where the abnormal growth was more elongated. As this had numerous, stunted, small branches along the sides, it possibly in time would have developed similarly to the other, which was evidently older. No cause was found for either trouble, though winter injury might offer a plausible explanation in the absence of any other.

Yellow Stem-Spot. Plate XLV, a. On the young branches of

white pine one or two seasons old, there frequently develop, especially in the vicinity of Norfolk, evident golden or yellow spots on the green bark. These spots are usually about a quarter to a third of an inch in diameter and very frequently center from the base of a leaf bundle whose leaves may also be yellowed at their base and shorter than normal. As these spots resemble so nearly, in color, the blister-rust infection spots on the leaves and occur most conspicuously in a region where blister-rust had escaped into the woods, we thought that they might be the first signs of stem infection by this fungus. Continued search of microscopic sections made through such spots, however, has uniformly failed to show any evidence of mycelium. The next suspicious agent was the spittle bug, as this insect was quite abundant on these young twigs in that vicinity, but as yet no definite connection between the two has been shown. Injury by bending is said to cause similar spots.

Pine, Umbrella, *Sciadopitys verticillata.*

BLACK SCURF, *Rhizoctonia Solani* Kühn. The mycelium of this fungus was found by entomological inspector Zappe creeping abundantly over the stems of young Japanese umbrella pines just imported from Holland. It had not caused much injury however. Packing the plants closely in a closed case no doubt favored its development.

Pleroma, *Pleroma splendens.*

Intumescence. Plate XLVI, b. This unusual trouble on the leaves of a Pleroma plant was sent to the Station in Oct., 1916, by Dr. F. H. Williams of Bristol. Although he had owned the plant for twenty years, this malady had only shown during the last three or four. During the winters the plant was kept in a window on an enclosed stoop, steam heated, and in the summers was planted outdoors, usually in shade. As the white fly had troubled it the last winter, it was cut back to the roots when taken out doors and planted in the sun. It made a fair new growth outdoors, with no trouble showing, and when transferred indoors continued to grow rapidly with the intumescences appearing in the leaves. Later formed leaves, however, did not show the trouble.

The very small pimply outbreaks, faintly shown in the illustration because of the hairy covering, were confined chiefly to

the upper surface of the leaves and were usually thickly placed over the whole surface. They resembled somewhat extraneous deposits since when wet they had a gelatinous-like appearance. Sections through the leaves showed that they were formed by a morbid growth of unusually elongated cells. We think the trouble was due to unusual turgor brought about in the developing leaves from excessive water supplied by the roots. Cutting back the plants severely, planting them in the sun outdoors, and then transferring them to the partially shaded stoop, with the presence of numerous hairs on the leaves to lessen transpiration, all were factors in upsetting the proper balance between water supplied by the roots and its transpiration from the leaves.

Several American papers have appeared, most of them recently, on intumescence of leaves. Von Schrenk (Mo. Bot. Gard. Rep. **16**: 125-48. 1905.) describes and figures intumescences on cauliflower leaves due to various copper sprays. Smith (Journ. Agr. Res. **8**: 165-86. 1917.) similarly treats of intumescence on this same host produced by various chemical vapors. Harvey (*Ibid.* **15**: 83-111. 1918.) relates where they were caused on cabbage by frost. Wolf (*Ibid.* **13**: 253-9. 1918.) gives injury from wind-blown sand as an ultimate cause of such trouble on cabbage.

Poplar, *Populus* sps.

EUROPEAN CANKER, *Dothichiza populea* Sacc. & Briard. Plate XLVII, a. This disease has been well described by Hedgecock and Hunt (Mycol. **8**: 300-8. 1916.). It was first called definitely to our attention in Connecticut by F. A. Bartlett (Tree Talk **4**: 76. 1917.) from Stamford in 1917. We are not sure, however, that the canker trouble mentioned in our 1903 Report, p. 347, was not due to this fungus. In recent years specimens have been received from Stonington, Hartford, New Canaan and New Haven. It is found in nurseries as well as on private grounds, and in our experience seems to be more or less associated with winter injury. The Lombardy poplar is the most common host here. On smooth bark of smaller branches it forms a brownish dead area with the fruiting stage evident as small erumpent pustules. On older branches or the main trunks quite evident cankers, as shown in the illustration here, may develop. When these girdle the stem the parts beyond die.

Potato, *Solanum tuberosum.*

While not as a rule so serious as the fungous diseases, non-parasitic troubles of the potato are at least more numerous in this state. They are due to a variety of causes but chiefly to unfavorable or unusual weather conditions. A few are caused by other environmental factors; some are constitutional, being inherited from the preceding crop; one or two are somewhat infectious. Regarding the weather conditions, mention should be made of the year 1918, when an unusually large number of these troubles appeared, due in part to the effect of the severe winter of 1917-18 on the stored tubers and in part to the wet-spring, dry-summer weather that followed. In the previous Reports we have discussed briefly a few of these troubles, such as tip-burn, internal brown spot, spray injury, etc., and in the following pages fifteen more are added to this list.

Aerial Tubers. Plate XLVII, b. Occasionally there has been sent to the Station for examination and explanation potato vines producing abnormal swellings on the stems above ground. In such cases usually some injury has occurred on the stem beneath the ground, thereby cutting off the food material manufactured in the leaves from being transferred to the rootstocks where it is stored in the tubers. As a result of injury below, the material is stored in the stem above ground in these unusual aerial tubers. Injury to the stem by the *Rhizoctonia* fungus is one of the common causes of these monstrosities. In both 1916 and 1917 fine examples of aerial potatoes were reported; Plate XLVII, b, shows some of those found on plants in a Yalesville field where the injury was caused by *Rhizoctonia*. Orton (U. S. Dept. Agr. Bull. 64: 33. 1914.) has described a case of aerial tubers on leaf roll plants where there was no injury to the base of the plants. Phloem-necrosis, no doubt, had its influence in this case, as the elaborated sap is carried down the stem through the phloem.

Black Heart. This trouble, as indicated by its name, shows as a blackening of the tissues at the center of the tuber. Often this blackening is accompanied by large cavities. It has only been reported to us once or twice, in recent years, from this state.

Bartholomew (Phytopath. 3: 180-2. 1913.) found it developed on potatoes shipped in heated cars and he was able to produce it in the laboratory "when potatoes taken in April and May from

storage cellars were exposed to a temperature of about 38° to 45°C, in an ordinary drying oven for from eighteen to forty-eight hours."

Stewart and Mix (N. Y. Exp. Sta. Bull. 436: 321-62. 1917.), who also studied the trouble, succeeded in producing it by cutting down the supply of oxygen needed for the slow changes that take place in the dormant tubers. They therefore concluded that the trouble results from improper storage conditions, such as poor ventilation and piling the potatoes too deeply in bins and cars, as well as by too high a storage temperature.

Curly Dwarf. Plate XLVIII, a. As indicated by the name and by the accompanying illustration, this trouble applies to potato plants of a decided dwarfed development, with curling and wrinkling of the foliage. Orton (*loc. cit.*: 37-40. 1914.) writes: "The stem and its branches, the leaf petioles, and even the midribs and veins of the leaves all tend to be shortened in many cases to a very marked extent, and particularly in the upper nodes of the plant, so that the foliage is thickly clustered. Typical curly-dwarf is readily distinguished from leaf-roll by the wrinkled or downward curling of the leaves, the normal color of the foliage and the firmness of the leaves, which do not lack turgidity."

We have occasionally found curly-dwarf plants in potato fields in this state, but do not believe it is as common here as in some potato districts. It is an hereditary trouble transmitted through the tubers. Quanjer (Phytopath. 10: 35-47. 1920.) claims that curly-dwarf is only an extreme case of mosaic.

Frozen Tubers. During the winter of 1917-18, because of its severity, many potatoes in farm storage in this state were frozen. Badly frozen tubers soon rot, so they are of no value. Others only slightly hurt are often put on the market. Such tubers tend to darken, when cut. We believe that some of the unusual troubles, such as spindling sprout, that developed in the potato crops of 1918 were due to potatoes so injured.

Hollow Heart. Plate XLVIII, b. This is a name applied to potatoes that have a conspicuous cavity in their center. Large potatoes, especially those of certain varieties as Dibble's Russet, are more apt to develop such cavities than the smaller tubers. Usually the trouble appears in a season favorable for rapid

growth, especially if dry weather is followed by very wet. The cracking of the fruit in certain varieties of peaches and musk melons is a similar phenomenon in our opinion.

Leaf Roll. Plate XLIX, a. This trouble is distinguished by a decided upward roll of the margins of the leaves, and often is accompanied by more or less color changes. The plants often make a fairly normal growth otherwise. It is easily distinguished from the work of aphids by the upward, instead of the downward, roll of the leaf margins. Leaf roll has been much studied in Europe (See Orton, *loc. cit.*: 18-33.) and there are various opinions concerning it. There seem to be at least two types, one merely a seasonal trouble due to unfavorable weather conditions, as too much wet weather followed by dry, and another that is a constitutional and more serious trouble. Most of the roll we have seen in this state on both potatoes and tomatoes we believe to be of the former type. In 1918, however, in a yard in Westville, we saw what may have been the second type. It was quite evident on Gold Coin, but not on other varieties grown near by. True leaf roll, according to Quanjer, is a phloem-necrosis trouble and is both contagious and pseudo-hereditary.

Mosaic. This chlorosis trouble of potato foliage was first noticed by the writer in this state in the early summer of 1916. Both Green Mountain and Irish Cobblers, the two varieties most commonly grown here, showed the trouble. It was seen again in 1917 in several fields, but probably not so prominently on the whole, as in 1916. In 1918 it was more prominent but in 1919 it was less evident than in any of these years, due apparently to favorable weather conditions for foliage growth. The leaves show a yellow-green mottling and some crinkling of the foliage, something like the mosaic of tobacco but usually not so prominent. As the vines grow older this mottling usually becomes less rather than more prominent. Mosaic tubers from Maine, furnished the writer by the U. S. Dept. of Agr. and planted at Mt. Carmel in 1919, failed to show any more signs of mosaic on their leaves than did the so-called checks from the same source. The former, on the other hand, were a less thrifty strain, as shown by the size of the vines, etc.

We have not noticed that Connecticut potato fields were very materially affected as to vigor or yield of tubers, but in Maine

and some other states where this trouble is more prominent, it is said that mosaic plants give smaller yields. In Bermuda Wortley (Rep. Dir. Agr. 1914 and 1915.) reports this trouble very bad on Bliss Triumph. He found the yield from mosaic tubers to be half that from tubers of mosaic free plants. As a result of his investigations importation of seed stock into this island is regulated to guard against bringing in this trouble from badly infected fields.

Quanjer of Holland, *loc. cit.*, and Schultz *et al.* of the U. S. Dept. of Agr. (Journ. Agr. Res. 17: 247-73. 1919.) have done much work on this disease and their experiments show that it is not only a constitutional trouble carried by the tubers, but it is contagious in the field. The latter investigator found aphids as one of the carriers of the trouble from diseased to healthy plants.

Net Necrosis. Plate XLIX, b. We have previously described in one of our Reports an internal brown spot of potato tubers that is somewhat similar to this. In net necrosis, however, the brownish diseased areas are smaller and more net-like. Neither is caused by fungi and their nature is not well understood. It is thought by some that net necrosis is connected with some of the other troubles described here.

Potash Hunger. In 1917 and 1918 there was some indication that potatoes suffered from lack of potash, especially on certain soils and where manure was not used abundantly. Such plants are said to show more or less bronzing of the foliage and are apt to flop over easily or turn yellow and die prematurely and are subject to early invasion by saprophytic fungi. It is hard to tell, in our opinion, potash hunger from unbalanced fertilization or from the drought injury described here in detail under Wilt and Prematuring, *q. v.*

Premature Sprouts. Plate L, a. Another trouble of potatoes reported as not uncommon in both 1916 and 1917 was the premature sprouting of the tubers before being dug. Usually only occasional hills in the fields showed this trouble, so that the injury was not very great, and the sprouts found were not elongated, being something like those shown in the illustration. However we did see cases in 1917 where these sprouts not only became elongated but appeared above ground and formed foliage.

Sometimes the sprouts merely developed into small secondary tubers. Such are sometimes found on sprouting old tubers in storage.

We are not sure of the cause of this premature sprouting but believe it may be caused by plants receiving a serious set-back, as by drought, before they are fully matured, and then having a favorable period for growth start into activity again. Such conditions we know will cause "knobby" tubers. Knobby tubers are often found in fields where tip-burn or blight has badly injured the vines but still left them vigorous enough to respond to a later favorable growing period.

Rootstock Invaded-Tubers. Plates L, b, LI, a. An occasional injury is found in potato fields where the rootstocks of some other plant penetrate the tubers themselves. Nut grass, *Cyperus* sp., not infrequently causes injury of this kind. The most serious injury of this same nature we have seen was in a field of Mr. Arthur Clark at Orange in 1917 and was caused by quack grass, *Agropyrum repens.* Here the slender rootstocks of the grass, as shown in the illustration, not only bored into many of the tubers, but in some cases went clear through them, coming out at the opposite end and formed a leafy shoot above ground. It is a question whether these penetrating rootstocks receive any nourishment from the potato tubers. The tissues of the two plants evidently form no union, though in some cases, short side sucker-like branches were formed. No noticeable injury of tissues in their vicinity was observed; in fact the rootstocks seemed to force their way through the tubers with no special discoloration of the invaded tissues. Such invaded tubers have no market value.

Russeted Tubers. Plate LI, b. This name is applied to tubers with a thicker or rougher skin. Certain varieties have a more russeted skin than do others, but under certain conditions the skin in the same variety may be rougher than normal. The sample shown here is an unusual or areated russeted type. It came from Maine seed potatoes and probably, as in other cases, was due to some external irritant, like a fertilizer, acting on the skin when quite young, and stimulating it to form an unusual corky growth.

Spindling Sprout. Plate LI, c. The chief characteristic of this trouble is the slender needle-shaped sprouts that appear in

place of the normal lead-pencil thick sprouts. The trouble was not uncommon in 1918 but we saw little of it before or since. This leads to the belief that it is in some way connected with freezing or too cold storage of the tubers in the preceding winter. Spindling sprouts grow into very weak small plants that yield poorly if they survive. One grower in 1918 plowed up his entire field as worthless. Stewart and Sirrine (N. Y. Agr. Exp. Sta. Bull. 399: 133-43. 1915.) have studied this trouble rather carefully, and while they do not know the cause they found home-grown seed developed the trouble much more than northern grown, where the trouble rarely occurs. Excessive heat and drought are given by them as a possible cause.

Wilt and *Prematuring*. Plate LII, a. There appeared suddenly, in 1918, in southern Connecticut an unusual trouble popularly designated as a blight, which was first called to the writer's attention on July 6th in a field that had grown potatoes for three years. In this field a spot had yellowed up and was dying prematurely, and the owner said that he had first noticed the trouble two or three days previously. Later the writer saw many similar fields and received numerous complaints. The trouble seemed to be a complicated one with indications that more than one factor entered into it. However, our general conclusion was that primarily it was not due to fungi but rather to lack of sufficient moisture and food for continued normal plant growth.

The fields visited showed two or three types of the trouble, as follows: 1. A prematuring of the vines in which the stem and leaves gradually turn yellow, the plant often remaining erect, the leaves dropping off or dying, and finally the whole plant succumbing. 2. Plants wilting and flopping over as if the stem had not strength enough to support them. Parts normally green and no particular spotting of the stem. 3. A bronzing and spotting more or less of the stem; plants lopping over somewhat; frequently the stem was soft near the ground so that it was easily pinched together, as if some fungus or borer had been at work.

We carefully examined the stems above and below the ground in the field, and cut many sections of the stems in the laboratory, and while occasionally bacteria and fungous threads were seen which might aid in wilting, and a *Phoma* that possibly might cause rotting, we found no definite association of these particular agencies with the trouble.

The wilt first showed on Irish Cobblers or other early varieties. Irish Cobblers and Green Mountains are the varieties most frequently planted in this State, and are the ones on which the trouble appeared most prominently. Dibble's Russet was the least injured variety seen. We have since learned that it is a variety quite resistant to drought injury.

The time of planting or maturing of the potatoes seemed to have had considerable to do with the appearance of the disease. In other words, the trouble did not develop until the plants had bloomed and were in that stage where the foliage had made its growth and most of its energies were used in the formation of tubers. The trouble quite often was very prominent on Irish Cobblers when Green Mountains beside them did not show it, or on Irish Cobblers when near-by rows of the same variety planted a few days later did not show it. In time, however, both the Green Mountains and the later planted Cobblers did have the trouble when they reached the right stage of maturity. One farmer planted Irish Cobblers and Green Mountains on four different dates, covering a month, and the trouble appeared in the fields and varieties in the order of their planting and maturity, being quite severe on the earliest when just beginning to show up on the latest.

We saw many cases where the trouble showed over a field when the vines under shade trees, especially apples which are apt to be within the field, were still quite green and unaffected. In other cases where the field was quite irregular the vines were always green in the gullies on the lower portions where the earth was more moist and got the wash from the fertilization. Invariably in fields with gravelly knolls the trouble first appeared and showed more prominently in those spots, no matter what the fertilization. In fields insufficiently fertilized, the trouble was most pronounced, especially if only artificial fertilizers were used. Fields that had been heavily manured, or had a complete fertilizer containing potash, did not usually suffer like fields where only a 4-10 fertilizer was used. Fields of poor or leachy soil on which a 4-10 fertilizer was used were seen producing a fairly luxuriant growth under the favorable moist conditions of the spring and early summer, but going down when this fertilizer had been used up or leached out.

The lack of moisture had a very important bearing on this trouble and was also shown by injury to other plants, grass dying, and trees losing their foliage, from the dry hot weather of July 21st to 30th. The potato is more subject to drought injury than any of our cultivated crops, so naturally this was the first to show ill effects. Ordinarily this is shown as tip-burn but in 1918 the injury was not so much of this type as in the prematuring of the foliage.

All these facts led us to the conclusion that lack of moisture and in some cases insufficient plant food of which lack of potash was one of the chief factors, were primarily responsible for most of the troubles, rather than fungi, poor seed, or insects, especially lice, all of which were attributed as the cause.

Radish, *Raphanus sativus.*

Club Root, *Plasmodiophora Brassicae* Wor. This was sent us Sept. 20th, 1917, from Northford by Mr. Burnham and was the first collection on the radish from the state. See Kohlrabi in this Report.

Raspberry, *Rubus* sps.

Orange Rust, *Gymnoconia interstitialis* (Schl.) Lag. (*Puccinia Peckiana* Howe). Plate LII, b. In our 1903 Report under Blackberry, Dewberry and Raspberry we recorded the presence of the I stage (*Caeoma nitens*) of this fungus as occurring on these hosts in Connecticut. The recent work of Kunkel (Bull. Tor. Bot. Club. 43: 559. N. 1916.) however has shown that there are two forms in this country known under the general term *Caeoma nitens.* One of these germinates with a long non-septate germ tube, and the other with a short septate promycelium producing sporidia. Morphologically the spores of the two cannot be distinguished. The first form Kunkel calls the long cycled because it is the I stage (*Caeoma interstitialis* Schl.) of *Gymnoconia interstitialis*, also found in Europe, and the other he calls the short cycled since it apparently reproduces itself and has no connection with any other stage. This latter form he considers to be the true *Caeoma nitens* of Schweinitz. Arthur more recently (Bot. Gaz. LXIII: 501. Je. 1917.) has made this latter form the basis of a new genus and placed it under the species *Kunkelia nitens* (Schw.) Arth. He has made an

arbitrary attempt to determine the specimens of the I stage in his herbarium, placing them with one or the other of these genera (*Gymnoconia* and *Kunkelia*) chiefly according to the part of the country from which they came.

Later still an article by Atkinson (Am. Journn. Bot. 5: 79-83. F. 1918.) has appeared, in which he advocates from his investigations and the distribution of the two forms, that the life cycle of *Gymnoconia Peckiana,* as he calls it, is not definitely fixed so that in the warm climate of the south it produces the short cycled form and in the cool climate of the north the long cycled form, and in between sometimes one and sometimes the other according to the temperature conditions of June and July. This interpretation is based largely on the results of infecting raspberries at low temperatures (under bell jar with ice) with spores of the short cycled form from wild dewberry, *Rubus canadensis* as called in our paper, and producing the telial stage of the long cycled form. He thinks that under these cool conditions the short cycled form instead of forming a promycelium with sporidia, really formed the germ tube characteristic of the long cycled form.

For some years we have believed that the orange rust of Connecticut, found most commonly on wild dewberry, was distinct from that we studied previously in Illinois (Ill. Agr. Sta. Bull. 29: 273-300. 1893.) since here we never found the III or Gymnoconia stage associated with it. In fact, so far as we know, this stage had not been reported from Connecticut. The past three seasons (1917, '18, '19) in the light of Kunkel's investigations and with help of our assistant Dr. McCormick, we have tested the germination of the I stage obtained from numerous specimens on different hosts from various localities in the state. As a result of these germination tests we have found that both the long and the short cycled forms occur in this state. The classification of these collections according to their germination as given under the different hosts (Gray's 6th edition) is as follows:

Puccinia interstitialis (Schl.) Lag. Long cycled form. On *Rubus hispidus* (wild) 2 tests; *Rubus occidentalis* (cult.) 2 tests; *Rubus strigosus* (cult.) 2 tests; *Rubus villosus* (wild) 1 test; *Rubus* sp. (wild raspberry) 2 tests, (cult. raspberry) 1 test.

Caeoma nitens Schw. Short cycled form. On *Rubus cana-*

densis (wild) 19 tests; *Rubus hispidus* (wild) 1 test; *Rubus villosus* (cult.) 2 tests, (wild) 5 tests; *Rubus* sp. (wild raspberry), 1 test.

From the above it will be seen that out of thirty-eight tests only ten of them were of the long cycled form, and with seven of these we were able later in the season to go back to the same vicinity and collect the III stage on the same hosts and even on the same individuals where known! In three cases we were not able later to look for the III stage. At first we got the impression that the short cycled form only occurred here on blackberries and dewberries and the long cycled only on raspberries. While this seems to be generally true for this state, later results show that no host is infected by only one form, unless it is *Rubus canadensis*, the wild dewberry. From this host all of the 19 tests have yielded the short cycled form, and we have never collected the III stage of Gymnoconia on it. But even here some of the spores in the same cultures with the short cycled have given germ tubes that were of the long cycled type as far as determined without special staining. That *Rubus canadensis* is a possible long cycled host in this state we have further proved by an inoculation experiment as follows: Long cycled spores of the I stage from *Rubus hispidus* from Norfolk were placed June 11th in Petrie dishes on a leaf of *Rubus canadensis*. On July 14th there had developed on this leaf numerous mature sori of the III stage of *Gymnoconia interstitialis* (See Plate LII, b). On the same date I spores of the short cycled form on *Rubus canadensis* from Norfolk, collected at the same time, placed on a leaf of *R. canadensis* in a Petrie dish failed to produce any infection whatever! This we had tried before without results and also several times in the past have tried to infect plants in crocks of *Rubus canadensis* with spores from the same host and have never succeeded.

Our failures to secure infection of *Rubus* sps. with the short cycled form and the fact that it produces sporidia that might easily be blown some distance has led us to consider if it might not be a heteroecious rust having other stages (*Melampsora* for example) on entirely different hosts. So for some years past we have been trying to inoculate various hosts but without results. The hosts and years of inoculation are as follows: In

1914, on *Populus deltoides;* in 1916, on *Populus deltoides, P. grandidentata, P. tremuloides, P. alba?, Salix* sp.; in 1917, on *Salix* sps. (four); in 1918, on *Populus* sp.; in 1919, on *P. deltoides, P. grandidentata, P. tremuloides, Betula populifolia, B. lenta, Salix* sps. (two).

With Atkinson's theory that the same individual host in this locality may one year produce the short cycled form and another year the long cycled, according as the weather at the time is warm or cold, we cannot agree. We have in several cases tested the spores from the same definite locality during different years, and they have always given the same result. We have collected the III stage for three years on the same plants of *Rubus occidentalis* at Birdsey's, East Meriden, and the tests of the I stage there have always been long cycled. Furthermore we tried the germination of both long and short cycled spores several times at ordinary room temperature, and then tried their germination in iced water and got no different results. If temperature determines the type of germination why should collections made in the same vicinity on the same date but from different hosts give different types of germination? Also why in our higher room temperatures did we get both types of germination? We are inclined to interpret Atkinson's successful infection in 1917, where with so-called short cycled spores he produced the III stage on plants kept iced under bell jars as, due first, to the fact that he had favorable conditions for infection, and, second, to the probability that a few of the spores used normally produced germ tubes (long cycle) instead of sporidia (short cycled) as did the majority (just as we have occasionally found to be the case in our cultures from this host, as already mentioned) and it was the former only that produced the infection. In other words we believe that the short cycled form with its sporidia *does not infect the mature leaves but secures infection through the very young perennial* parts as is apparently the case with the sporidia of the III stage. This delays the appearance of the infection until the next year when the I stage is produced from the perennial mycelium. This would account for our failure to infect *Rubus* through the leaves with the short cycled form, and would explain the successful infections with this stage reported by both Atkinson and Kunkel the year after their inoculations were made.

From the observations of our own and those of the various other investigators we therefore come to the following conclusions.

(1) There are two forms (not species or genera) of the formerly so-called *Caeoma nitens* in this country. One of these produces only one spore stage, aecial spores, and can be termed *Caeoma nitens* Schw., and the other produces both aecial and telial spores and can be termed *Gymnoconia interstitialis* (Schl.) Lag.

(2) *Caeoma nitens* through the fusion of the two nuclei in the aecial spores, for some still unknown reason, has become a short cycled form and cuts out the telial stage entirely, but on germinating functions as such, as shown by development of a promycelium and sporidia. *Gymnoconia interstitialis* has aecial spores whose two nuclei do not fuse and so give rise to the ordinary germ tube and eventually to a mycelium with two nuclei to a cell.

(3) Infection from the aecial spores of *Gymnoconia interstitialis* takes place only through the stomates of the leaves and the telial stage results from this. Infection from both the aecial spores of *Caeoma nitens* and the telial spores of *Gymnoconia interstitialis* takes place only by the penetration of the germinating sporidia through very young tissue, usually that of the underground shoots, and this results in a perennial mycelium that the next season gives rise to the aecial stage in the leaves.

(4) *Caeoma nitens* is largely confined to a region south of Connecticut, and *Gymnoconia interstitialis* largely to the region north of this state, but in the intermediary region both forms may occur more or less commonly.

(5) In this intermediary region it is not impossible that the forms are not so definitely fixed but that occasionally on the same host both types of germination of the aecial spores appear; or possibly the same individual host occasionally becomes infected with both forms and both types of aecial spores are therefore produced on it.

(6) However, conclusion (5) does not mean that once the aecial spores on an individual plant, or any plant infected from these, show only the short or the long cycled type of germination that they can be changed to the other type by differences in weather conditions during that or any other season.

Romaine, *Lactuca sativa* var. *Romana.*

Chlorosis. In a private garden in the fall of 1916 at Middlebury, we saw an occasional plant of Romaine or Cos lettuce in which the leaves showed a yellow mottling and crinkling. This, while indicating an unhealthy condition of the plant, was no disadvantage so far as the edibility of the plant was concerned, as such plants were probably less bitter in taste due to less chlorophyll.

Rose, *Rosa* sps.

POWDERY MILDEW, *Sphaerotheca pannosa* (Wallr.) Lev. In July, 1919, specimens of Dorothy Perkins roses were brought to the Station from New Haven by their owner to learn what caused their failure to open properly. Many that did open made inferior blossoms that frequently died prematurely. An examination showed that the hips were covered, in part or entirely, with a thick whitish felt of the above fungus. This was made up of mycelial threads with few conidiophores, and doing little or no injury. On the inside, however, a less conspicuous mycelial growth, with plenty of conidia, was the cause of the injury to the petals, that prevented their proper maturity, etc. In the writer's garden the same trouble developed similarly but with the perithecia, deeply imbedded in the felty mat, finally appearing. The Dorothy Perkins was injured more than the Crimson Rambler. We have reported this fungus before but not on blossoms causing injury of this nature.

Fasciation. This specimen was found in April, 1918, by G. A. Stack in a yard in Westville. The stem as it started from the ground was about a third of an inch in diameter and only slightly flattened. It gradually flattened toward the top, which was broken off, until it was an inch and a half wide. The fasciation seemed to run off from one side since, for the entire length, one side was slightly marked by its thicker more rounded character until near the end where it was entirely separated as a distinct naturally rounded stem about a quarter of an inch in diameter. This extended for less than a foot but had been cut off here as had the flattened portion so the nature of the tips could not be determined. Stewart (N. Y. Agr. Exp. Sta. Bull. 328: 392. 1910.) describes and figures somewhat similar fasciations of rose which are said to be not uncommon. See Asparagus in this Report for other cases.

Rye, *Secale cereale.*

SCAB, *Gibberella Saubinetii* (Mont.) Sacc. The conidial stage of this fungus, which until recently has been known as *Fusarium culmorum,* was found in this state for the first time in two rye fields at Yalesville, in 1918. It occurs in the heads causing all or a part of the spikelets to die prematurely, the fungus showing at the base of these as a pinkish growth. While the disease is bad in the middle west, it does not seem to be at all common or serious here in Connecticut. The same thing occurs on wheat, *q. v.*

Spinach, *Spinacia oleracea.*

DAMPENING OFF, *Pythium deBaryanum* Hess. Mr. H. D. Johnson of Highwood called the writer's attention, late in September, 1919, to a young spinach field of his that had been seriously injured by the plants dampening off irregularly in the rows, making a very uneven stand. The plants had come through the ground during a rather wet period which proved to be especially favorable for the development of the disease since a field planted a short time later did not develop the trouble. The seedlings an inch or so high dropped over, the trouble first showing as a blackish or brownish softening of the tissue just below or above ground. After falling over they wither up in dry weather and soon disappear. Mr. Johnson had never been troubled before in this way and it was the first time we had seen dampening off in a spinach field, although we had seen the disease on other seedlings in seed beds and greenhouses.

An examination of the tissues revealed the presence of an abundant, guttulate, non-septate mycelium of the phycomycetous type, but no very evident spore stage, except possibly temporary sporangia. After the seedlings were left in water for a few days a rather luxuriant growth of mycelium developed around them and in this appeared the temporary sporangia, and finally definite oogonia and oospores. These agreed very well in size and appearance with those grown in artificial cultures recently received from the Department of Agriculture at Washington. Plate LVI.

The oogonia varied from 18-27μ, chiefly 20-25μ, and the oospores from 15-21μ, chiefly 16-18μ. The oogonia and oospore walls remain hyaline and the latter are not very thick, usually 2-2.5μ. It seems characteristic of this fungus to produce

oogonia much more readily in a liquid than in a dry medium, so that a portion of our agar cultures transferred to water in a Petrie dish developed them much more abundantly than before. On oat agar the fungus rapidly develops a very prominent, fluffy, aerial, white growth, with some oogonia and temporary sporangia. The temporary sporangia look much like unfertilized oogonia. On roots of peas and corn (*q. v.*) this same year we found different specimens with larger oospores that we have placed under *Phytophthora cactorum*.

Spruce, Norway, *Picea excelsa.*

FELT FUNGUS, *Coniophora byssoidea* (Pers.) Fr. Mr. Walden found this fungus on young plants of Norway spruce imported from France in 1918. In the packing cases it had developed a very conspicuous felty growth of the tawny mycelium over the individual stems running up onto them from the soil. Whether it caused any harm was uncertain but probably it was developing merely as a saprophyte under these favorable conditions. Dr. Burt confirmed our determination of the species.

Sumach, *Rhus glabra.*

Fasciation. Near the Station grounds a stem of the common sumach was found in 1919 that from the ground up gradually flattened out until the flattened part was twice the normal width of the stalk and much thinner. The end was bifurcated into short tips curved in opposite directions. Brannon (Bot. Gaz. 58: 518-26. 1914.) describes a fasciation of cottonwood and willows on young sprouts from stumps of trees cut down the year before, and discusses the causes of this and other cases of fasciation. See Asparagus in this Report.

Sweet Pea, *Lathyrus odoratus.*

ROOT ROT, *Phytophthora cactorum* (Cohn & Leb.) Schroet. In our Report for 1907, p. 359, under Sweet Pea we mentioned *Pythium* and *Rhizoctonia* as causes of dampening off. The specimens discussed there were brought to us in July, 1907, by Mr. Walden of this Station from his garden. A re-examination of them shows that the so-called *Pythium,* whose oogonia with oospores were present in the cortical tissues of the roots, is the same thing that in the present Report we have discussed under

peas and called *Phytophthora cactorum.* The oospores from the sweet pea are figured in Plate LVI, 3, and can be compared with those found on the other hosts reported here.

ROOT ROT, *Fusarium* sp. As well as the garden pea, the Sweet Pea has similar rots due to *Rhizoctonia, Phytophthora* and *Fusarium,* and the effect produced by all three is much the same, in that the half-grown plants turn yellow, wilt and dry up due to the rotting of the roots and base of the stem. The *Fusarium* specimens reported here were sent from the Stoeckel estate at Norfolk, in June, 1918. The fungus is probably the same species that causes more or less trouble in greenhouses on cuttings, etc.

Sycamore, *Platanus occidentalis.*

Electrical Injury. Trees near trolley lines are sometimes apparently killed by leaks in the feed wires. In the summer of 1918, a sycamore tree along the trolley line in Centerville showed such injury on a single branch which had come in contact with the feed wire where the insulation was worn off. A decided burn showed on the under side of the branch, and the leaves had all died. The insulation on the feed wire was evidently quite poor and for a distance of half a mile small twigs here and there on the street trees could be seen that had recently been killed, apparently when the wet leaves came in contact with the poorly protected wire.

Tobacco, *Nicotiana Tabacum.*

Besides the troubles described here we have run across several more, chiefly of the leaf spotting type, but because of their obscure nature we have omitted consideration of them for the present. All of the troubles discussed, except the first, are of a non-parasitic nature.

BACTERIAL SOFT ROT, *Bacillus carotovorus* Jones. Plate LIII, b. The only place where we have seen this trouble was on W. J. Reeves' tobacco at Windsorville. We first saw it there with Johnson of the Wisconsin Station, in July, 1918, and found it there again in 1919. Only a few plants in the field showed the trouble but these were mostly in the same row or near each other. The disease starts at the lower end of the plant, rotting out the pith so that the stem can easily be crushed with slight pressure though the outside may seem nearly normal. The rot

eventually reaches and invades the veins and tissues of the leaves when they drop down and finally die. Johnson (Wisc. Agr. Exp. Sta. Bull. 237: 27. 1914.) has briefly mentioned this trouble under the designation "hollow stalk." He claims it can be produced by inoculation and we succeeded in so doing by cutting into healthy plants and inserting diseased tissue. Not having worked on the trouble from a bacterial standpoint, we merely assume that it is not different from the ordinary soft rot troubles found here on a variety of plants.

Fire Injury. Occasional tobacco plants under tents are more or less injured by the cloth of the tents catching fire and the burning fragments falling down on the leaves. Sparks from locomotives, cigarettes and incendiarism are causes of such fires. Some growers have supplied watchers to prevent them. See Lightning Injury.

Frost Mottling. Plate LIII, a. A curious case of frost injury to young tobacco plants was called to our attention the latter part of July, 1918, by Mr. Beinhart, the Government tobacco expert, at the tobacco farm of Mr. Eastwood in Somers. The owner noticed the trouble about the first of July, shortly after there had been an unusually late frost in that neighborhood. During the two weeks that had elapsed since first seen by Beinhart and then by both of us, the injury had become less conspicuous according to him. At the latter date the plants still showed considerable spotting and some irregularity of leaves, especially of the lower older ones. The spotting was due to the chlorophyll being killed in spots that were now whitish or white and so in strong contrast with the rest of the normally green tissues. Sometimes these white spots were large areas and sometimes small specks of a mottled arrangement, as shown by the two leaves photographed. Such injury follows light frosts, with possibly moisture on the leaves where their tissues are injured.

Hail Injury. Plate LIV. On August 4, 1917, we visited, with Beinhart and Johnson of the Dept. of Agriculture, the region in East Suffield where a storm on Aug. 2d had caused injury to the tobacco. This storm was rather local, doing great injury to some fields, while other fields near by suffered little. A good many large trees or their branches were blown down by the high wind. Tobacco in the open was more or less blown

over and had to be propped up again. The greatest injury, however, was from hail, which in a streak through the region inflicted great damage to the tobacco in the open, numerous fields of which were largely or entirely ruined; it also caused damage to the tobacco under tents in some cases. This latter damage occurred where the wind was strong enough to carry the cloth from the tents. We saw a tent of ten acres where the wind had whipped the cloth to pieces, bent and blew over much of the tobacco, as shown in the photograph taken by Johnson, while the hail entirely ruined what was not injured by the wind.

The hail injury was very marked on the stems, showing white irregular spots where the stones struck. See photo. These spots were entirely on the side of the stem from which the storm came. The leaves were largely shredded from the stem or beaten off on the ground and cut in irregular shapes. The damage caused to this one tent alone was probably five or six thousand dollars. We have seen tents where half a ton of hail stones tore down the cloth and were piled on the ground so that some of them remained there for twenty-four hours afterwards in warm weather.

Lightning Injury. Plate LV, a. Lightning may cause injury to tobacco in two ways. First, it may strike the field and produce injury in circular spots for a short distance around where it struck. This is apt to occur when the tobacco is young, the electricity following the moist earth comes in contact with the stems where it entirely kills the plant, or produces cankers up the stem and injury to the petioles. It also usually produces a permanent curling or a wilting of the leaves, as shown in the photograph. Some growers think that tobacco does not do well in after years on these spots. In one of our Reports we mentioned such injury, investigated by Stoddard, and in 1916 Beinhart showed us another field where similar injury had occurred. He also told of other cases which he had seen.

The second kind of injury which may be produced by lightning is where it strikes the tents running along the wires supporting the cloth, setting the latter on fire. The heat from the burning cloth, or more especially where the flaming particles fall on the tobacco beneath, may cause considerable injury. Some tent fields are protected by insurance against fire injury. When fire occurs

from lightning or other causes, the men, as soon as the fire is discovered, try to limit its spread by cutting through the cloth with corn knives. We saw a field at Scantic, near Bloomfield, which had been struck by lightning and injury caused to the plants under the small portion of the tent burned over. These plants were not entirely killed but showed brown dead spots on the leaves where the heat had been most intense, or the flaming material had touched them.

Potash Hunger. During 1919 we had called to our attention several fields where tobacco was doing poorly for no apparent cause. The leaves often were yellowed and finally spotted and the plants undersized. So far as we could determine the trouble seemed to be a fertilizer difficulty due to insufficiency of potash, of which the tobacco plant is a strong user. We know too little of the trouble, however, to speak positively.

Red Root-Rot. There were also fields or parts of fields, both under tent and in the open, that in 1919 did poorly, evidently because of a reddish rotting of the roots. This trouble did not seem to be caused by fungi. Whether or not the fertilizers used then or in the past had anything to do with the trouble is as yet undetermined, but it appeared to be more a trouble of that kind than of one caused by fungi.

Tulips, *Tulipa* sp.

White Spot. Plate LV, b. In May, 1919, there was called to our attention a curious trouble of tulips of the Darwin type at the Hammer estate at Branford. Each year the trouble was said to appear so that because of it the growing of tulips was being abandoned. Tulips that were picked early and taken into the house did not develop the injury. This showed as numerous small, elliptical, white spots standing out in strong contrast to the variously colored tissues of the petals. At first the spots were greyish or blackish but finally became white with the collapsing of the tissues. The trouble occurred to a much less extent on the leaves.

Jones and Miller (Phytopath. 9:475-60. 1919.) have recently described a somewhat similar injury on the leaves of tulips, which they call frost necrosis. We were at a loss to account for the injury at Branford, but it is possibly a frost injury, since

there were late frosts that year that did considerable harm to other vegetation. This would scarcely explain, however, its presence each year. Before seeing the Jones article we had about concluded that this trouble was due to smoke injury from a nearby steel reducer. It was only rarely, but at this time of the year, that the smoke was carried over the tulip beds.

Turnip, *Brassica* sps.

TURNIP APHIDS killed by *Empusa Aphidis* Hoffm. In the summer of 1916, lice, *Aphis pseudobrassicae,* were very prevalent on both white and yellow turnips, causing a partial failure of the crop. After most of the harm was done to the turnips, this fungus got started and killed off millions of these lice. Collections were made in September in Mt. Carmel, New Haven and Westville where practically all of the lice on the leaves were killed. The fungus is similar to the species that kills house flies and the brown tail moth larvae.

Umbrella Tree, *Magnolia tripetala.*

Chlorosis. In May, 1916, we received from Southport partially developed leaves of the umbrella tree showing a very marked yellow-green mottling over the whole surface, resembling mosaic of tobacco. As the letter stated that the bark was dead in places and the tree had been ailing since the previous August, it seemed certain that it had been injured in some way, probably winter injury as it is a little out of its range so far north, and that the mottling of the leaves was the result of very poor nutrition on this account.

Wheat, *Triticum vulgare.*

GLUME BLOTCH, *Septoria* sp. We collected this fungus once or twice in our disease survey work in 1918 as a very inconspicuous parasite on the glumes and leaves of wheat.

POWDERY MILDEW, *Erysiphe graminis* D. C. A little of this mildew was found in both 1918 and 1919 in wheat fields. It was too inconspicuous to cause any damage. On rye and barley, however, we have found it causing much more injury and making a more conspicuous growth.

SCAB, *Gibberella Saubinetii* (Mont.) Sacc. Johnson and Haskell (U. S. Dep. Agr. Pl. Dis. Surv. Bull. No. 8, pp. 21-26.

1919.) now give this *Fusarium* fungus the above name and report it very serious in the upper Mississippi valley and eastward, in 1919. We found it first in Connecticut in 1917, and collected it again in 1918, but as on rye, *q. v.*, it seemed to cause little damage in this state.

STINKING SMUT, *Tilletia foetens* (B. & C.) Trel. We also found this smut very sparingly in the grain of wheat in 1918. While very serious in the west, it is a rare fungus here in Connecticut, this being our first collection though we had reported it before in cattle feeds.

Willow, *Salix* sp.

POWDERY MILDEW, *Uncinula salicis* (D. C.) Wint. This powdery mildew occurs more or less commonly on the upper surface of the leaves of certain basket willows at the Station's farm at Mt. Carmel.

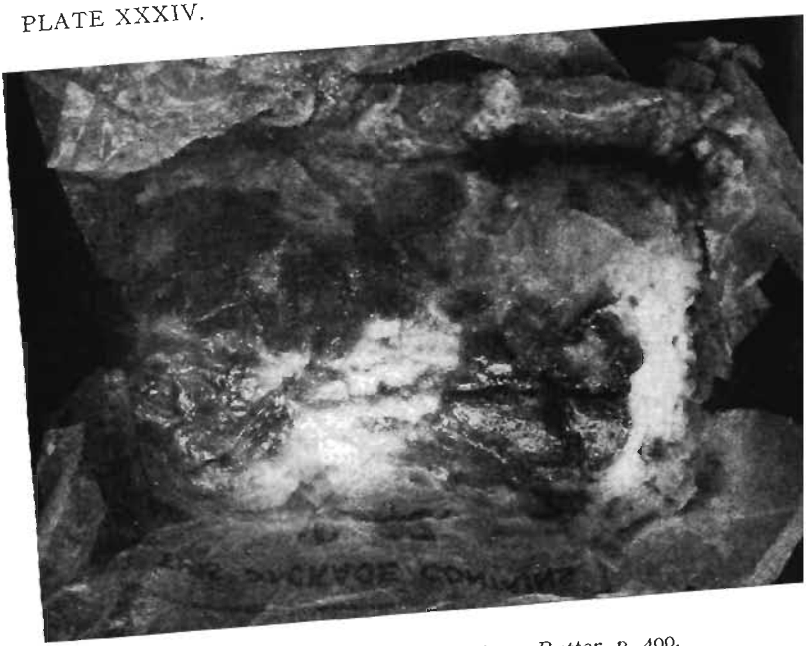
a. General View of Invaded House.

b. Rotten Condition of Living Room Floor.

c. Luxuriant Growth of Fungus on Underside of Boards, etc.

DRY ROT FUNGUS, *Merulius lacrymans*, p. 398.

PLATE XXXIV.

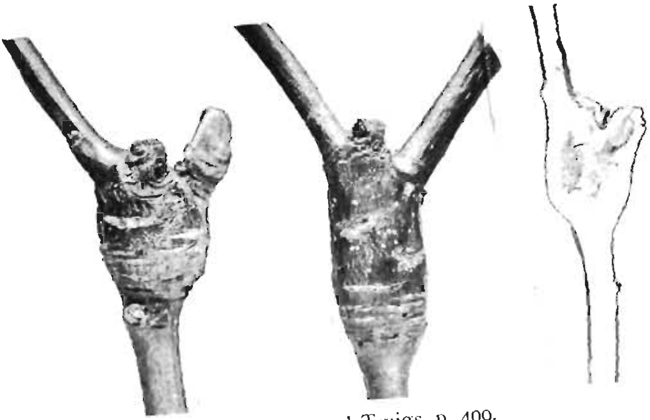


a. Mold of Unsalted Package Butter, p. 400.

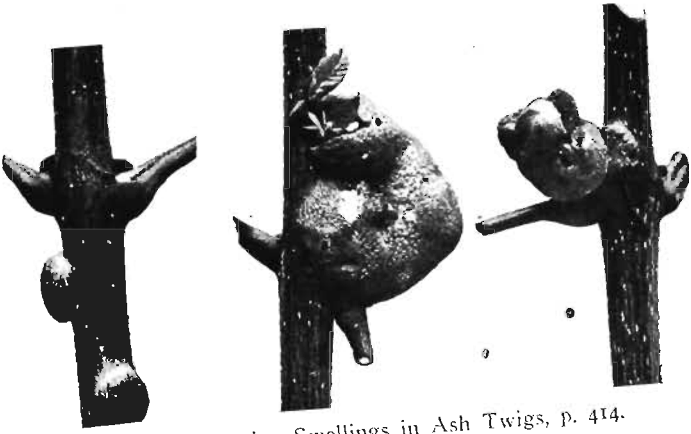
b. Bacterial Fruit Spot, p. 404.

TROUBLES OF BUTTER AND APPLE.

a. Aerial Crown Gall, p. 408.



b. Malformed Twigs, p. 409.



c. Rust causing Swellings in Ash Twigs, p. 414.

TROUBLES OF APPLE AND ASH.

PLATE XXXVI.

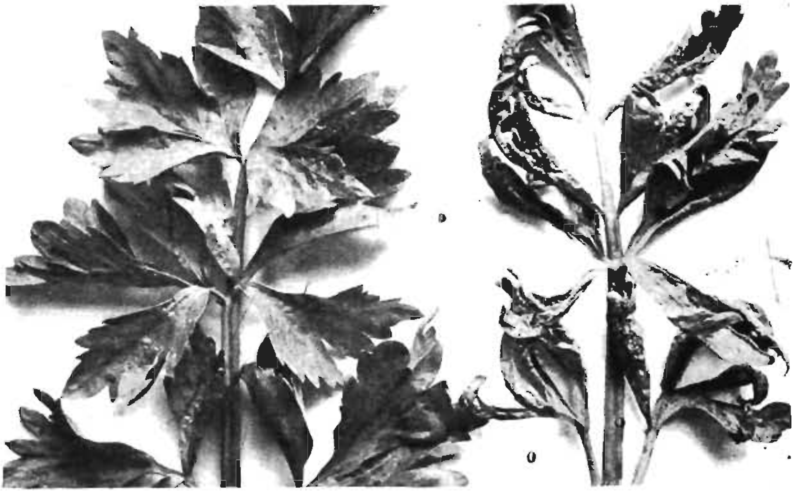
a. Fasciation, p. 415.

b. Black Leg of Cabbage, p. 420.

c. Bacterial Wilt of Beans, p. 417.

TROUBLES OF ASPARAGUS, BEANS, CABBAGE.

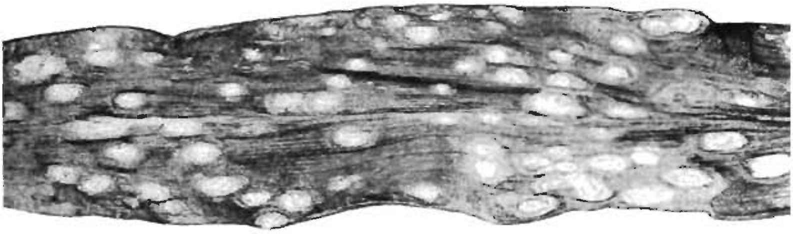
a. Soft Rot of Chinese Cabbage, p. 422.



b. Healthy and Crinkled Celery Leaves, p. 424.

TROUBLES OF CHINESE CABBAGE AND CELERY.

PLATE XXXVIII.



a. Pellucid Spot Disease of Corn, p. 430.

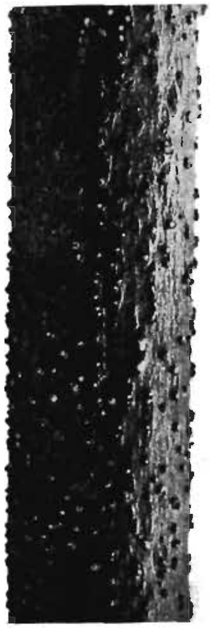
b. Connate Fomes of Hickory, p. 440.

c. Witches' Broom of Hickory, p. 440.

TROUBLES OF CORN AND HICKORY.

PLATE XXXIX.

a. Anthracnose, p. 441.



b. Red Canker, p. 442.

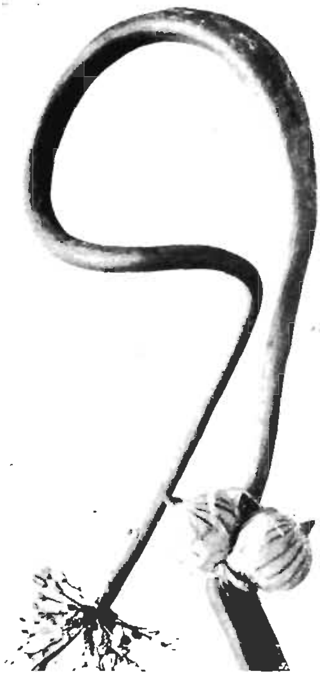
c. Club Root, p. 443.

d. Sulphury Polypore, p. 445.

TROUBLES OF HORSECHESTNUT, KOHLRABI, OAK.

PLATE XL.

a. Bastard and Normal (central) Onion Blossoms.



b. Bulblet Head.

c. Double Head.

TROUBLES OF ONION, 448.

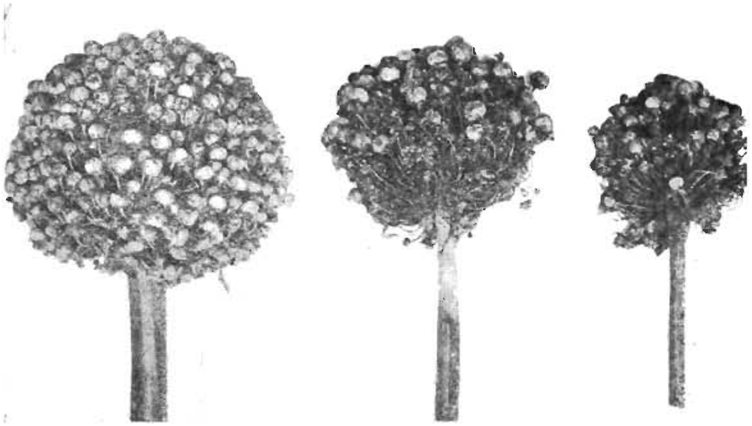
a. Goose Neck, p. 448.

b. Elongated Spathe, p. 448.

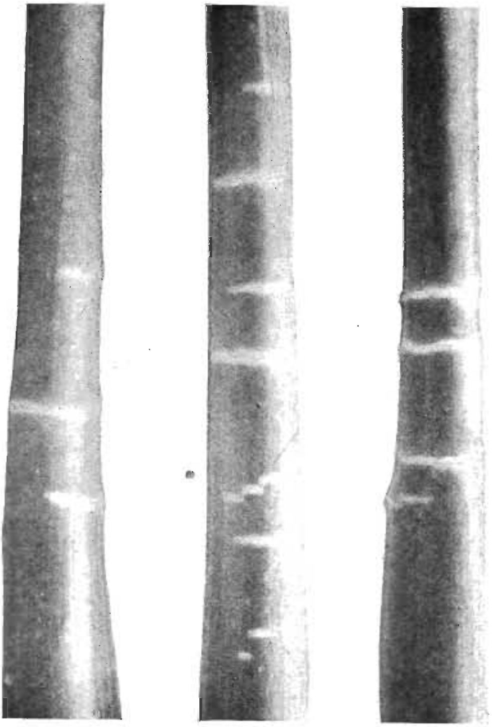
c. Hail Injury, p. 449.

TROUBLES OF ONION.

PLATE XLII.



a. Normal and Blasted Heads, p. 447.



b. White Ring, p. 449.

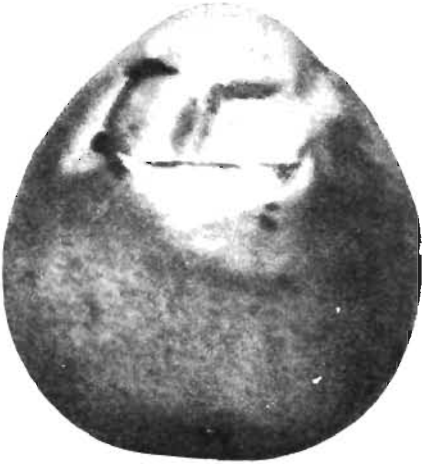
TROUBLES OF ONION.

a. Die Back, p. 454.

b. Winter Injured Orchard, p. 454.

TROUBLES OF PEACH.

PLATE XLIV.

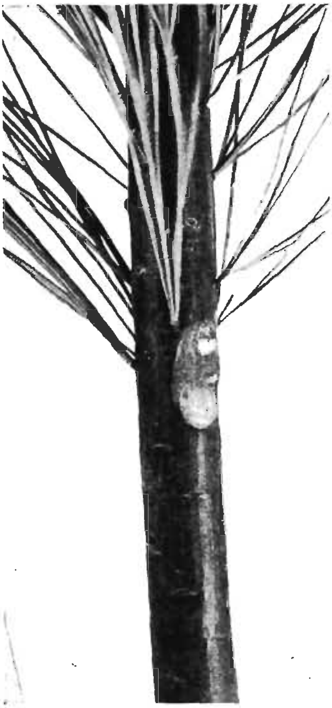


a. Downy Mildew Rot, p. 454.

b. Lightning Injury, p. 458.

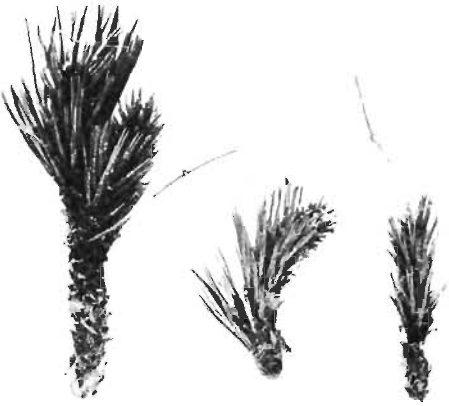
c. Snow Bend, p. 458

TROUBLES OF PEAR AND WHITE PINE.



a. Yellow Spot, p. 459.

b. Witches' Broom, p. 459.



c. Winter Injury of Buds, p. 458.

TROUBLES OF PINES (a. White, b. Scotch, c. Austrian).

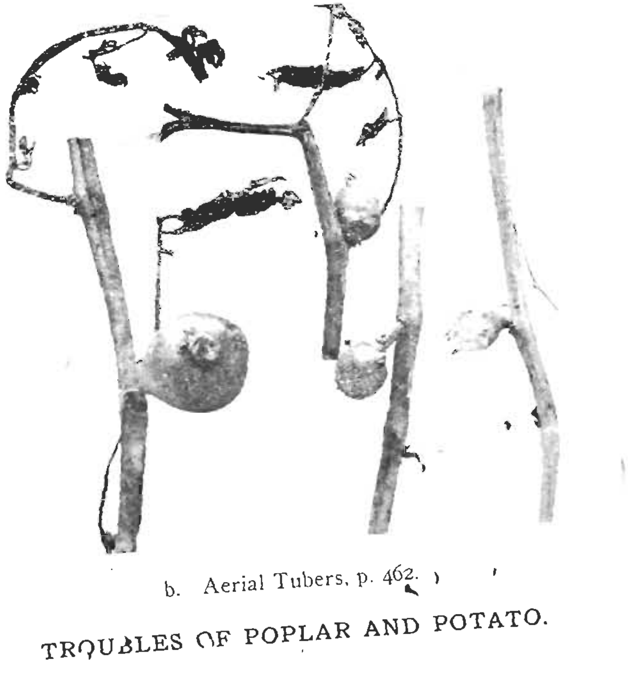
PLATE XLVI.

a. Witches' Broom. p. 459.

b. Intumescence, p. 460.

TROUBLES OF WHITE PINE AND PLEUROMA.

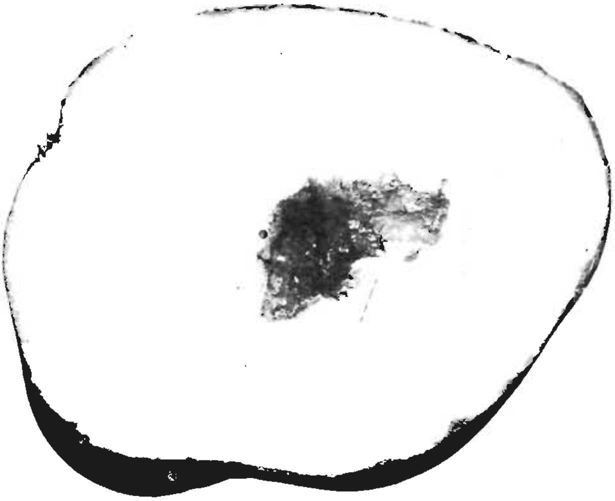
a. European Canker, p. 461.



b. Aerial Tubers, p. 462.

TROUBLES OF POPLAR AND POTATO.

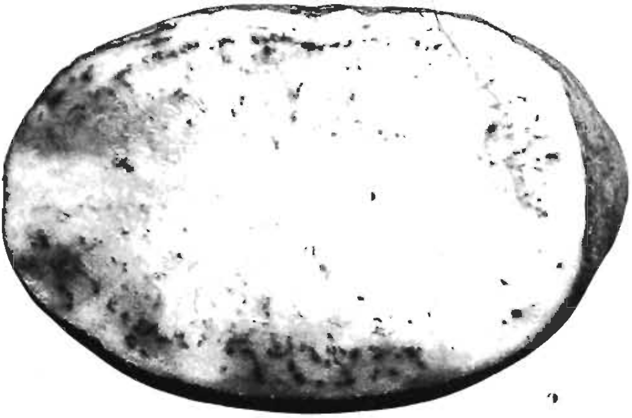
a. Normal and Curly Dwarf Vines, p. 463.



b. Hollow Heart, p. 463.

TROUBLES OF POTATO.

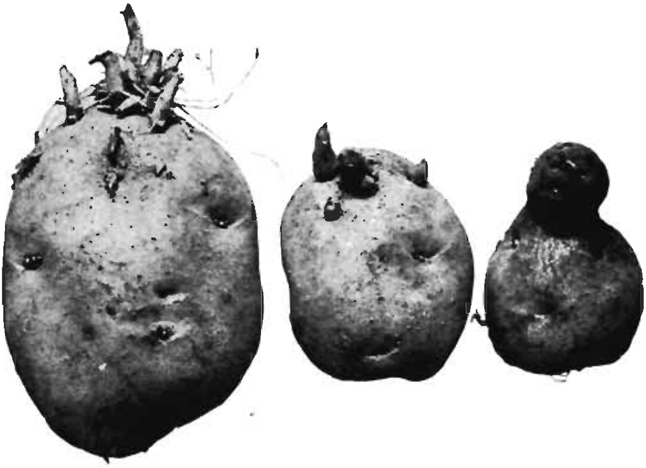
a. Leaf Roll, p. 464.



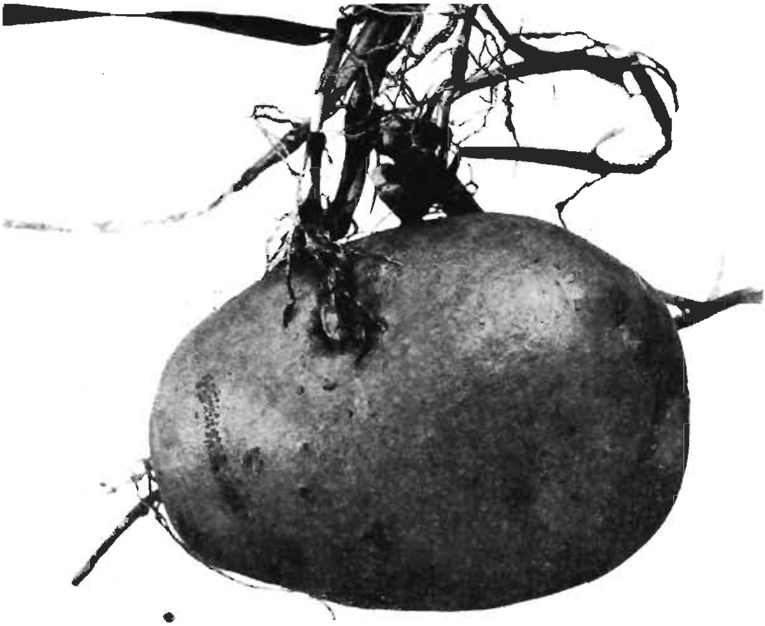
b. Net Necrosis, p. 465.

TROUBLES OF POTATO.

PLATE L.



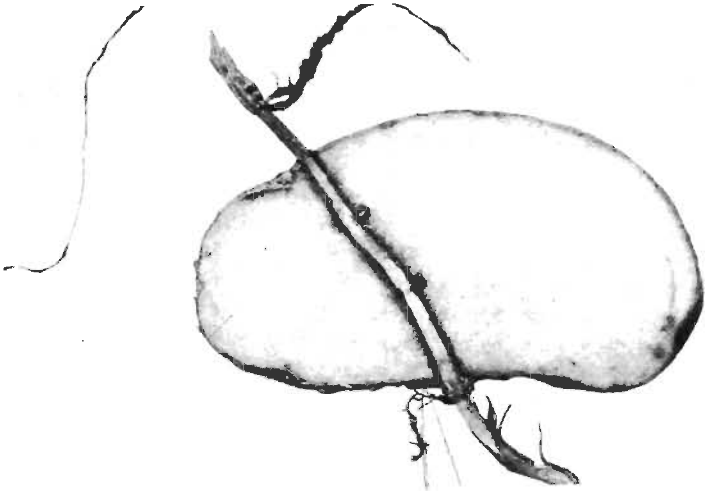
a. Premature Sprouts, p. 465.



b. Rootstock Invaded-Tubers, p. 466.

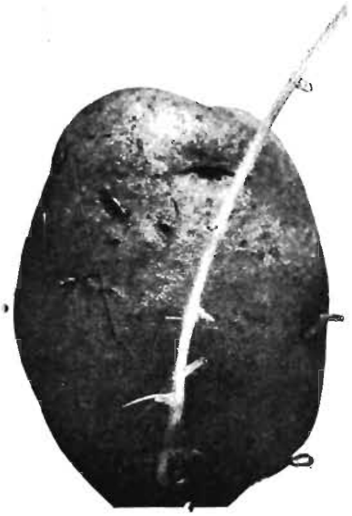
TROUBLES OF POTATO.

PLATE LI.



a. Section through Rootstock Invaded-Tuber.

b. Russeted Tuber.



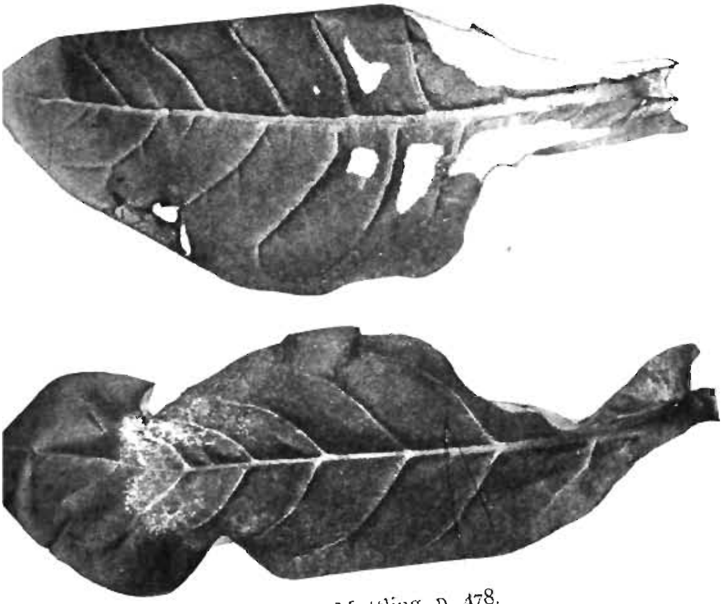
c. Spindle Sprout.

TROUBLES OF POTATOES, p. 466.

a. Wilt of Potato in Center Row, p. 467.

b. III Stage of Rust, p. 469.

TROUBLES OF POTATO AND RUBUS.

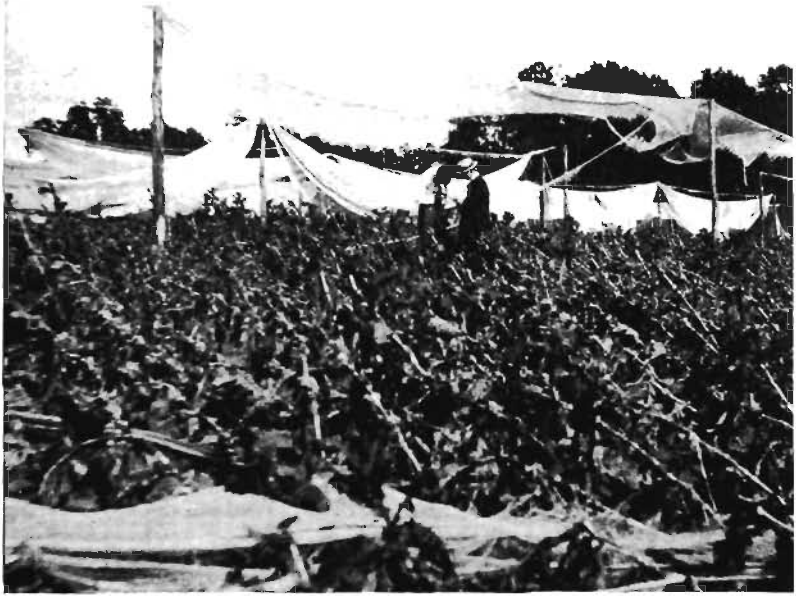


a. Frost Mottling, p. 478.

b. Bacterial Soft Rot, p. 477.

TROUBLES OF TOBACCO.

PLATE LIV.



a. Tent and Tobacco Destroyed by Wind and Hail.

b. Showing Laceration and White Spots.

HAIL INJURY OF TOBACCO, p. 478.

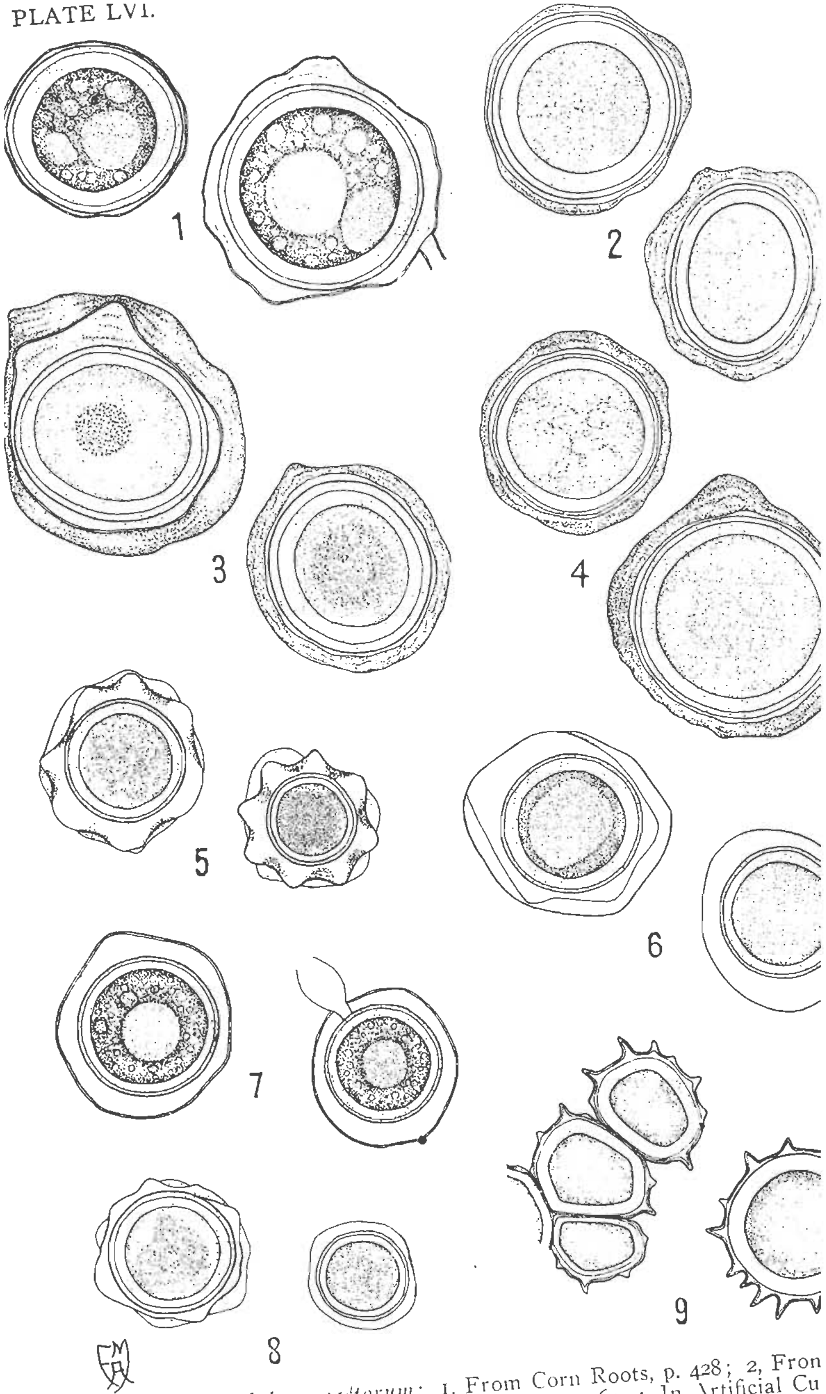
PLATE LV.

a. Lightning Injury, p. 479.

b. White Spot, p. 480.

TROUBLES OF TOBACCO AND TULIP.

PLATE LVI.



1-4, *Phytophthora cactorum:* 1, From Corn Roots, p. 428; 2, From Roots, p. 452; 3, From Sweet Pea Roots, p. 476; 4. In Artificial Cu from Pear, p. 454. 5-8, *Pythium deBaryanum:* 5, From Celery I p. 423; 6, From Spinach Seedlings, p. 475; 7, In Artificial Test Culture and, 8, in van Tieghem Cell Culture Drying Out, p 9, *Pythium hydnosporum* From Grape Berries, p. 436.

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